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	5,000 ft.	3.39
	6,000 ft.	(3.25)
	7,000 ft.	(3.26)
	8,000 ft.	(3.27)
	9,000 ft.	(3.28)
	10,000 ft.	(3.29)
	12,000 ft.	(3.30)
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	6,000 ft.	3A.1
	7,000 ft.	3A.1
	8,000 ft.	3A.2
	9,000 ft.	3A.2
	10,000 ft.	3A.2
	11,000 ft.	3A.2
	12,000 ft.	3A.3
	13,000 ft.	3A.3
	14,000 ft.	3A.3
	15,000 ft.	3A.3
	16,000 ft.	3A.4
	17,000 ft.	3A.4
	18,000 ft.	3A.4
	19,000 ft.	3A.4
	20,000 ft.	3A.5
	21,000 ft.	3A.5
	22,000 ft.	3A.5
	23,000 ft.	3A.5
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EMERGENCY OPERATING PROCEDURES

GENERAL INFORMATION

General

It is impossible to set down rules which will cover all emergency situations. The crew duties and assignments which follow will, however, provide a maximum of efficiency for most situations. In situations not specifically covered in the following pages, the successful handling of the emergency is dependent on good judgment and wherever applicable, use of the following procedures as a guideline.

Furthermore, there is a possibility that in the event of a serious emergency, time will not permit sending an SOS. Therefore, any emergency should be evaluated and action taken. At the Captain's discretion the emergency may be reported to ground stations so that they will be alerted in the event the situation becomes serious. If the flight is able to proceed in a routine manner the ground stations will again be notified immediately. To ensure a successful ditching, it is imperative that each crewmember be thoroughly familiar with the entire emergency procedure. In order to abandon the aircraft in the minimum amount of time, it is essential that no confusion exist; therefore, each crewmember will be familiar with his own specific duties and, in addition, will familiarize himself with the entire procedure so that in the event of injury he can take over the duties of any other crewmember.

Sequence of Command

The following chain of command is established to eliminate any confusion as to which crewmember is in command should any crewmember become incapacitated.

1. Captain
2. Relief Captain (No Requirement at this time)
3. First Officer
4. Flight Engineer
5. Any extra crewmember

Use of Check Lists

When a malfunction is observed by one crewmember, he should make the other crewmembers aware of the situation as soon as possible. If applicable, the use of the check list should be initiated immediately after positive identification of the emergency. The Flight Engineer should call out and read the "challenge" items clearly and audibly and the crewmember(s) responsible for the "response" shall perform the required duty and respond clearly and audibly. The items in the blocked area are memory items.

In the Expanded Emergency Check List of this section, explanations, where deemed necessary, will follow the check list items.

EMERGENCY OPERATING PROCEDURES

1. Engine Failure on Take-off

A. Prior to Reaching V_1

If any engine fails prior to reaching V_1 abandon the take-off and proceed as follows:

Control column	Full forward
Power levers	Full reverse
Brakes	Full

B. After Reaching V_1

If an engine fails after reaching V_1, continue the take-off and proceed as follows:

(1) Keep nose wheel in contact with runway by forward pressure on control column.

(2) Leave power lever of failed engine in take-off position.

(3) Rotate at appropriate V_R speed.

(4) Landing gear UP after lift off; speed V_2.

(5) Move condition lever to FEATHER and complete propeller feathering and engine shutdown procedure for failed engine (Ref. Para 8).

(6) Continue climb at V_2 until critical phase of take-off is completed.

(7) Accelerate to minimum flap retraction speed and retract flaps.

(8) Continue to accelerate to final take-off climb speed and reduce power to max. continuous.

EACH CHECK LISTED ITEM SHALL BE READ AS A CHALLENGE AND ANSWERED WITH THE PROPER RESPONSE.

EMERGENCY OPERATING PROCEDURES

WARNING: DO NOT RETARD POWER LEVER OF FAILED ENGINE UNTIL CONDITION LEVER HAS FIRST BEEN MOVED TO FEATHER. RETARDING THE POWER LEVER AT THIS STAGE WILL CAUSE THE PROPELLER BLADES TO MOVE INTO A FINER PITCH.

(9) Continue climb at maximum continuous power and final take-off climb speed.

2. One Engine Failure En Route

In the event of an engine failing en route, the automatic drag limiting system will coarsen the propeller. To shut down the affected engine, complete the propeller feathering and engine shutdown procedure (Ref. Para 8). To obtain the certified en route flight performance, refer to relevant performance figures.

3. Two Engine Failure En Route

Should two engines fail while en route, the shutdown procedure remains the same, but the following points must be kept in mind:

(1) Electrical loads must be monitored.

(2) If both engines on either side are shut down, that side will suffer the loss of wing anti-icing.

(3) Should both inboard engines be involved, a loss pressurization will result.

(4) Shutdown of both port engines will immobilize the engine-driven hydraulic pumps.

(5) To obtain the certificated en route flight performance, refer to relevant performance figures.

(6) If both outboard engines fail, the cabin supercharger on engine No. 3 must be disconnected if it is desired to obtain the certificated performance.

4. Engine Fires

A. Engine Fire During Flight

An engine fire will be indicated by the lights and the bell of the master warning system. The warning light on the engine fire control panel and the condition lever warning light will both indicate the engine concerned. Proceed as follows:

EMERGENCY OPERATING PROCEDURES

Warning Bell	Cancel
Condition lever	FEATHER and pull up to arm FIREX
Fuel Booster Pump	OFF
Fuel Selector Switches	As required to isolate dead engine

If warning persists, discharge firex after the propeller has feathered, thus:

Firex Discharge Switch	SHOT 1
Firex Discharge Switch	SHOT 2 if fire persists

NOTE: Having extinguished a fire in one engine by selecting the related discharge switch to SHOT 1, should a fire develop in the other engine on the same side, the discharge switch for this engine must also be selected to SHOT 1 to operate the second bottle of the system.

NOTE: Do not select SHOT 2 unnecessarily because, once used, no protection remains for the adjacent engine of the same side.

NOTE: No. 3 tank booster pump supplies the empennage combustion heaters (anti-icing system). In the case of a No. 3 power plant fire the empennage heaters, if in use, will operate at a reduced output when this booster pump is switched OFF. The booster pump may be switched ON, if required, when the fire drill has been successfully completed.

Complete the propeller feathering and engine shutdown procedure (Ref. Para 8).

B. Engine Breather Overheat Warning

A breather overheat warning will be indicated on the master warning lights and the annunciator panels. Proceed as follows:

Condition Lever	FEATHER and FIREX ARMED

Complete the propeller feathering and engine shutdown procedure (Ref. Para 8).

NOTE: It is not necessary to discharge Firex for this emergency.

C. Engine Fire on the Ground

The procedure for extinguishing an engine fire on the ground is similar to that of an engine fire during flight except that all engines should be shut down so that ground fire crews many extinguish the fire without injury from the other engines.

5. Tailpipe Overheat

Power Lever	Reduce power until light goes out. If light remains illuminated after reduction of power to FLIGHT IDLE for one minute, it may be assumed that an overheat detector switch malfunction has occurred and normal power may be restored.

6. Electrical Fires

If an electrical fire develops, usually identified by an acrid smell, crew should don masks, breathe 100% oxygen, and proceed as follows:

A.	BATT/OFF/GPU Switch	OFF
	D.C. Main/Essential Bus Tie Switch	OFF
	A.C. Bus Isolate Switches (C.F. & V.F.)	BUS 'B' ISOLATE
	Generator 4 Control Switches (C.F. & V.F.)	TRIP

Wait two minutes. Then:

B. If smoke does not clear following Step A, proceed to Step C. If smoke clears following Step A, then:

(1) Generator 4 Control Switch (C.F.)	RESET

(2) If smoke does not reappear following Step B(1), then:

A.C. Bus Isolate Switch (C.F.)	NORMAL
BATT/OFF/GPU Switch	BATT
D.C. Main/Essential Bus Tie Switch	ON

EMERGENCY OPERATING PROCEDURES

Continue flight with above configuration.

(3) If smoke reappears following Step B(1), then:

Generator 4 Control Switch (C.F.)	TRIP
Generator 4 Control Switch (V.F.)	RESET
A.C. Bus Isolate Switch (V.F.)	NORMAL
BATT/OFF/GPU Switch	BATT

Continue flight with above configuration.

C. If smoke persists following Step A, proceed as follows:

Generator 4 Control Switches (C.F. & V.F.)	RESET
A.C. Bus Isolate Switches (C.F. & V.F.)	BUS 'A' ISOLATE
Generator 1 Control Switches (C.F. & V.F.)	TRIP

Wait two minutes. Then

D. If smoke does not clear following Step C, proceed to Step E. If smoke clears following Step C, then:

(1) Generator 1 Control Switch (C.F.)	RESET

(2) If smoke does not reappear following Step D(1), then:

A.C. Bus Isolate Switch (C.F.)	NORMAL
BATT/OFF/GPU Switch	BATT
D.C. Main/Essential Bus Tie Switch	ON

Continue flight with above configuration.

(3) If smoke reappears following Step D(1), then:

Generator 1 Control Switch (C.F.)	TRIP
Generator 1 Control Switch (V.F.)	RESET
A.C. Bus Isolate Switch (V.F.)	NORMAL

Continue flight with above configuration.

E. If smoke persists following Step C, proceed as follows:

Generator 2 Control Switch (C.F.)	TRIP
Generator 3 Control Switch (V.F.)	TRIP
Generator 1 Control Switches (C.F. & V.F.)	RESET

F. When smoke clears following Step E, proceed as follows:

(1) Generator 2 Control Switch (C.F.)	RESET

(2) If smoke does not reappear following Step F(1), then:

A.C. Bus Isolate Switch (C.F.)	NORMAL
BATT/OFF/GPU Switch	BATT
D.C. Main/Essential Bus Tie Switch	ON

Continue flight with above configuration.

(3) If smoke reappears following Step F(1), then:

Generator 2 Control Switch (C.F.)	TRIP
Generator 3 Control Switch (V.F.)	RESET
A.C. Bus Isolate Switch (V.F.)	NORMAL
BATT/OFF/GPU Switch	BATT
D.C. Main/Essential Bus Tie Switch	ON

Continue flight with above configuration.

7. Propeller Feathering and Engine Shutdown

The manual propeller feathering and engine shutdown procedure is as follows:

Condition Lever	FEATHER & FIREX ARMED

NOTE: In the event of the condition lever linkage jamming, a break-out mechanism has been provided in the pedestal to ensure that, with approximately 40-pound effort, the condition lever can be moved to actuate the vital electrical circuits, i.e., feather pump, fire-wall shut-off valves and firex, hydro-electric feathering will not be available under these circumstances.

Buel Booster Pump	OFF

NOTE: No. 3 tank booster pump supplies the empennage combustion heaters (anti-icing system). In the case of engine No. 3 shutdown during use of the empennage heaters, this booster pump should be left ON. If the nature of the emergency is such that it is essential to switch this booster pump off, the empennage heaters will continue to operate at a reduced output.

Fuel Selector Switch for Inoperative Engine	Tank-Manifold
Electrical Power	Manually trip constant-frequency a.c. and variable-frequency a.c. generators and check change-over. Check d.c. power normal (27 volts).
De-icing	All propeller, cowl and nacelle scoop de-icing OFF for dead engine.

CAUTION: PROPELLER AND COWL DE-ICING FOR THE INOPERATIVE ENGINE MUST BE PLACED OFF REGARDLESS OF ATMOSPHERIC CONDITIONS.

CAUTION: SHOULD THE FEATHER PROPELLER TEND TO ROTATE IN THE REVERSE DIRECTION, THIS MUST BE PREVENTED BY REDUCING AIRSPEED AND/OR MOVING THE CONDITION LEVER TO FUEL OFF AND MOMENTARILY PLACING THE FEATHER PUMP SWITCH ON. AFTER PROPELLER ROTATION HAS CEASED, RETURN THE CONDITION LEVER TO FEATHER. TOTAL NUMBER OF FEATHER PUMP OPERATIONS, TO PREVENT PROPELLER ROTATION, MUST NOT EXCEED 4, EACH OF ONE HALF SECOND MAXIMUM DURATION.

EMERGENCY OPERATING PROCEDURES

CAUTION: IF THE PROPELLER DOES NOT FEATHER WITHIN 20 SECONDS OF MOVING THE CONDITION LEVER TO FEATHER PROCEED AS FOLLOWS:-

Engine Start Selector Switch	Appropriate Engine
Feather Pump Switch	ON and hold

CAUTION: THE FEATHER PUMP CAN FULLY DEPLETE THE FEATHERING RESERVE IN THE ENGINE OIL TANK IN ONE MINUTE, AND THE FEATHER PUMP SWITCH SHOULD NOT BE DEPRESSED FOR A LONGER PERIOD.

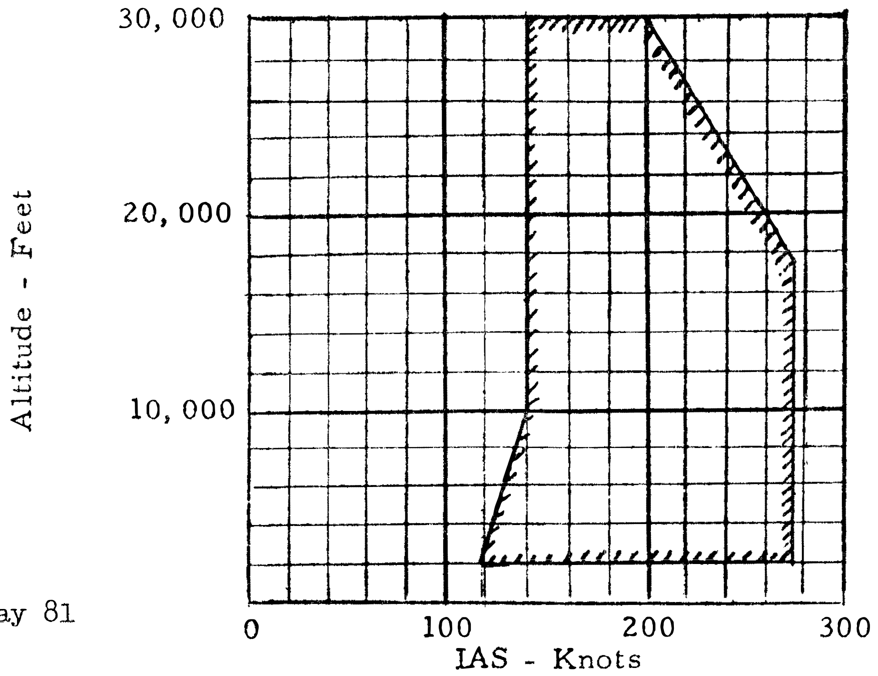
NOTE: If initial feathering action is unsuccessful, further one minute attempts may be made at intervals of three minutes (the engine scavenge pumps at ADLS RPM will restore the feathering reserve in this time).

If; however, intermittent action of the feather pump is desired then a ratio of 10 seconds of pump operation to 30 seconds of scavenge time should be observed.

Fuel Management	In accordance with normal Fuel Consumption Schedule, within permissible asymmetric fuel limits.

8. ENGINE RELIGHTING AND PROPELLER UNFEATHERING

Engine relight characteristics vary with airspeed and altitude. In general, relighting is more easily effected at higher airspeeds and lower altitudes. The envelope of airspeeds and altitudes over which satisfactory relights have been demonstrated is illustrated below.



Engine Relight Flight Envelope

EMERGENCY OPERATING PROCEDURES

The pilot flying the aircraft will call for the relight check list. This will be read by the Flight Engineer as follows:

P. and F.E. indicate actions required by the Pilot and Flight Engineer respectively.

1. E. Condition Lever........................FEATHER
2. P. Power Lever............................FLIGHT IDLE
3. F.E. Fuel Selector..........................TANK TO ENGINE
4. F.E. Booster Pump...........................ON-WARNING LIGHT OUT
5. P. Oil Temperature........................ABOVE-15°
6. P. Engine Start Selector..................SET TO ENGINE
7. P. Condition Lever........................FUEL OFF
8. P. Start & Feather Pump Switch............ON & HOLD

NOTE: Before the pilot presses the start and feather pump switches, he will brief the F.E. regarding his duties during the relight. The briefing will cover the following points:

A. F.E. will move condition lever smartly to the START position upon observing an LPRPM of 36% (32% above 170K).
B. F.E. will monitor T.G.T. for normal light-up and check oil pressure. Pilot will remove hand from switches when light-up is established.
C. When T.G.T. and LPRPM stabilize F.E. will move condition lever over the hump. If all engine instrument readings are satisfactory, move lever to trim position and call "ENGINE READY".

9. F.E. Condition Lever........................START
10. F.E. T.G.T. and Oil Pressure................CHECKED
11. P. Start and Feather Pump Switches........OFF
12. F.E. Condition Lever........................TRIM POSITION
13. P. Start Selector Switch..................ALL
14. F.E. Generators.............................RESET
15. F.E. Anti-Icing.............................NORMAL

9. Emergency Engine Relighting

If two or more engines flame out, proceed as follows:

Power Levers	FLIGHT IDLE
LP RPM	Above 36%
Start Switch	Continuous ignition

10. Propeller Overspeeding

In the event of a propeller overspeeding, reduce airspeed and attempt to feather the propeller using the propeller feathering and engine shutdown procedure. (Ref. Para 8). If this proves unsuccessful, open the power lever fully to attempt to reset the automatic drag limiting system.

EMERGENCY OPERATING PROCEDURES

If the overspeeding continues, carry out emergency de-pressurization and commence a low speed emergency descent. When reaching as low an altitude as practical, repeat feathering attempts.

11. Go-Around/Missed Approach - Four Engines

In the 45° flap, gear down configuration.

Power Levers	Full Power
Airspeed	$1.2V_S$ Increase to V_2 at a safe altitude.
Flaps	15°
Landing Gear	Up when obvious aircraft will not contact runway.
Airspeed	During climb increase to minimum flap retraction speed.
Flaps	UP
Power Levers	95% LP rpm

Continue as for normal all-engine take-off.

12. Go-Around/Missed Approach - Three Engines

In the 30° flap, gear down configuration.

Power Levers	Full Power
Landing Gear	UP
Airspeed	$1.3V_S$
Flaps	Retract to 15° while maintaining above airspeed
Airspeed	Change to V_2 and maintain until a safe altitude has been reached then increase to minimum flap retraction speed.

Flaps	UP
Power Levers	95% LP rpm

Continue as for three-engine take-off.

13. Emergency Operation of Landing Gear

If the landing gear fails to extend and lock down upon normal selection, repeat the normal procedure several times before resorting to emergency procedure.

A. Landing Gear Fails to Extend

1.	Main hydraulic system	UNLOAD
2.	Landing Gear Selector Lever	DOWN
3.	Landing Gear - Act. Circuit-breaker (D.C. Essential Bus A)	PULL
4.	Emergency Air Vent Valve	CHECK CLOSED
5.	Landing Gear Emergency Extension Switch	ON
6.	Landing Gear Indicator	CHECK SAFE

CAUTIONS: 1. DO NOT SELECT THE MAIN HYDRAULIC SYSTEM TO LOAD NOR RESET THE LANDING GEAR ACTUATOR CIRCUIT-BREAKER UNTIL PRESSURIZED AIR HAS BEEN VENTED FROM EMERGENCY LOWERING DOWN LINES.

2. AFTER AN EMERGENCY EXTENSION IN WHICH A SAFE INDICATION HAS BEEN OBTAINED, THE BLEED ORIFICE IN THE EMERGENCY DOWN LINE WILL ALLOW PRESSURE GRADUALLY DISSIPATE AND THE BOGIE BEAM MAY POSSIBLY ROTATE SUFFICIENTLY TO PRODUCE AN UNSAFE INDICATION. AFTER EMERGENCY AIR EXTENSION, THE EMERGENCY EXTENSION SWITCH MAY BE SELECTED OFF TO CONSERVE THE EMERGENCY AIR PRESSURE SUPPLY, AND RESELECTED TO ON PRIOR TO TOUCHDOWN. ALTERNATIVELY, AFTER EMERGENCY AIR EXTENSION, THE BOGIE CAN BE REPOSITIONED AND THE SAFE INDICATION RESTORED BY USE OF THE HAND PUMP OPERATING PROCEDURE.

EMERGENCY OPERATING PROCEDURES

NOTE: Nose wheel steering is not available when the landing gear has been lowered by the emergency air extension system.

Air pressure should extend and lock the gear. If the landing gear still fails to extend, use the hand pump operating procedure (Ref. Para. 13C).

B. Landing Gear Extends - Indicators Show Unsafe

BOGIE TEST Switch	Press

If indicators show safe, fault is in bogie rotation.

Main hydraulic system	UNLOAD
LANDING GEAR - ACT. Circuit-Breaker (D.C. Essential Bus A)	Pull
Landing Gear Emergency Extension Switch	ON

Air pressure should rotate and lock bogie.

CAUTION: DO NOT SELECT MAIN HYDRAULIC SYSTEM TO LOAD NOR RESET THE LANDING GEAR ACTUATOR CIRCUIT-BREAKER UNTIL PRESSURIZED AIR HAS BEEN VENTED FROM EMERGENCY LOWERING DOWN LINES.

If the bogie(s) fail to lock, use the hand pump operating procedure as follows:-

C. Hand Pump Operating Procedure (Landing Gear)

If either of the preceding emergency procedures fail or D.C. electric power is lost, use the hand pump as follows, but do not change the position of any of the landing gear controls.

Hand Pump Manual Selector	L.G. EMERG & BRAKE ACC.
Hand Pump Selector Switch	LANDING GEAR
Hand Pump	Operate until locked down indication is obtained.
Landing Gear Indicator	Check Safe

EMERGENCY OPERATING PROCEDURES

D. Retraction of Landing Gear Following Emergency Air Lowering, or Upon Unsafe Indication Following Retraction

Retraction of landing gear following emergency lowering is not recommended as there is a possibility that the uplock actuator may not retract thereby preventing the gear from locking up. However, should it be necessary to attempt a retraction, proceed as follows:

Emergency air vent valve lever	Down for 60 seconds then return to position
Landing Gear Act. Circuit-breaker	Reset
Main Hydraulic System	LOAD

If Main Hydraulic System pressure builds up:

Landing Gear Lever	UP

If Main Hydraulic System pressure does not build up:

Auxiliary Hydraulic Pump	ON
Landing Gear Lever	UP

If Main Hydraulic System pressure still does not build up:

Emergency Air Vent Valve Lever	DOWN
Hand Pump manual selector	MAIN SYSTEM
Landing Gear Lever	UP
Hand Pump	Operate until lock up indication is obtained

E. Cocked Nose Wheel

Nose Wheel Steering Disconnect Switch	OUT

Unload main hydraulic system if any uncontrollable veering tendency is encountered after touchdown.

14. Emergency Operation of Wing Flaps

A. Asymmetric Flap Condition

Occurrence of an asymmetric flap condition approximating 3° will illuminate the Wing Flap Fail Warning light on the Master Warning System, and will automatically de-energize the normal flap actuating circuit; the alternate flap circuit will remain operable, however.

Proceed as follows:

Alternate Flap System Switch	ALTERNATE
Alternate Flap Operating Switch	Inch flaps up or down, as necessary, to decrease unbalanced lateral trim, until flaps are symmetrical or warning light is extinguished. No further change to flap position should be made.

B. Flap Control System Failure

Failure of flaps to operate upon normal selection, or to not reach the selected position, may be caused by mechanical or electrical fault in the flap actuating system. If fault is mechanical, no further change to flap position can be made; if electrical, flaps can be operated with alternate system. Proceed as follows:

Alternate Flap System Switch	ALTERNATE
Alternate Flap Operating	Attempt to inch flaps up or down to desired position. If unsuccessful, no further action should be taken.

NOTE: Failure of one drive motor will reduce the rate of flap movement to 50% of normal rate both in up and down direction and with either normal or emergency system. Certain types of electrical faults will reduce the rate to 50% in a given direction only.

15. Emergency Operation of Brakes

In the event of total brake failure, braking may be effected by use of reverse up to maximum reverse power, reducing power as aircraft comes to a stop to avoid reverse taxying. Should difficulty be experienced with nose wheel steering, selection of the nosewheel steering switch to OUT permits castoring of the nose wheel within its limits and turns can be made by use of differential brake or engine.

Total loss of normal hydraulic system supply will leave only brake accumulator pressure. If brake accumulators are fully charged approximately 11 full brake applications are available.

Additional hydraulic pressure can be delivered by the hand pump to the brake accumulators.

Hand Pump Manual Selector	L.G. EMERG & BRAKE ACC.
Hand Pump Selector Switch	EMERG. BRAKE
Nose Wheel Steering Switch	OUT
Anti-skid	OFF
Hand Pump	OPERATE

16. High Speed Emergency Descent

Power Levers	FLIGHT IDLE
Landing Gear	UP
Flaps	0°
Dive at M_{NO} or V_{NO}	

17. Low Speed Emergency Descent

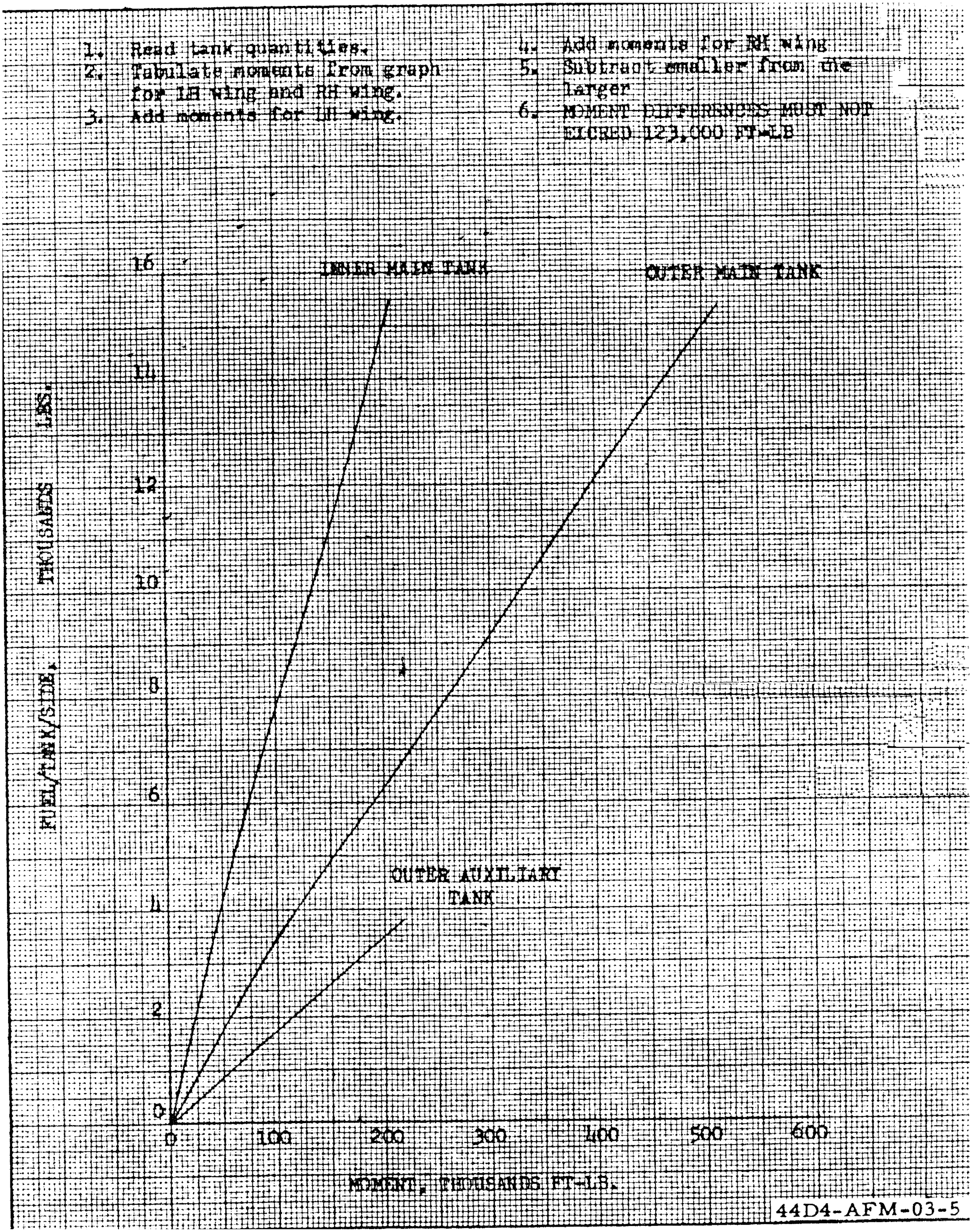
Power Levers	FLIGHT IDLE
Landing Gear	Down below 180 knots IAS
Flaps	45°

Dive at a speed not exceeding 153 when below 14,000'.
Dive at a speed not exceeding 176 when above 14,000'.

18. Emergency Fuel System Operation

If imbalance of fuel occurs due to an emergency fuel system operation, the maximum permissible lateral moment due to asymmetric fuel distribution between L.H. and R.H. tanks is 123,000 FT/LBS.

The lateral moment for any fuel distribution may be found by use of Figure 1 in accordance with the instructions on that page.



1. Read tank quantities.
2. Tabulate moments from graph for LH wing and RH wing.
3. Add moments for LH wing.
4. Add moments for RH wing
5. Subtract smaller from the larger
6. MOMENT DIFFERENCES MUST NOT EXCEED 123,000 FT-LB

Asymmetric Fuel Lateral Moments
Figure 1

EMERGENCY OPERATING PROCEDURES

The imbalance must be corrected so that the provisions of the following notes are complied with. (See Sec. 2 Page 8. Notes 1 thru 4).

A. Fuel Selector Valve Failure

The following procedure is an example of the actions to be performed should a failure of fuel selector valve in the TANK-ENGINE or OFF position coincide with a failed corresponding engine. With No. 1 engine failed and No. 1 fuel selector valve stuck in the TANK-ENGINE or OFF position, proceed as follows:

No. 2 Fuel Selector Switch	TANK-ENGINE-MANIFOLD
No. 1 Manifold Shut-off Valve Switch	OPEN (check flow to #1 tank established)
No. 2 Fuel Selector Switch	MANIFOLD-ENGINE
No. 2 Fuel Booster Pump	OFF
No. 1 Fuel Booster Pump Switch	OFF

When the indicated fuel content in No. 1 fuel tank has been reduced to 2140 pounds.

No. 2 Fuel Booster Pump Switch	ON
No. 2 Fuel Selector Switch	TANK-ENGINE
No. 1 Manifold Shut-off Valve Switch	CLOSE

NOTE: With this procedure, fuel is drawn from No. 1 fuel tank by No. 2 engine backing pump through the fueling valve into the manifold and through No. 2 Fuel Selector Valve. The procedure can be used for all four main tanks by selecting the appropriate valves and pumps. The procedure should be discontinued before the level of the fuel reaches the float valve. With the aircraft in level flight attitude, the recommended fuel quantity indications for discontinuance are as follows:

Tank No. 2 or 3	3500 pounds
Tank No. 1 or 4	2140 pounds

Always use adjacent engine on same side as the tank with the failed Fuel Selector Valve.

B. Main Fuel Tank Booster Pump Failure

When flying above 14,000 feet, fuel pressure to the engine with a failed booster pump may be obtained by proceeding as follows:

NOTE: With JP-4 type fuel, the LP fuel pump provides satisfactory operation up to an altitude of 14,000 feet and fuel temperature of 43°C. There is no altitude limitation for JP-1 type fuel.

A-1 8 A fuels are equivalent to JP-1.

All Fuel Selector Switches TANK-ENGINE-MANIFOLD

CAUTION: WHEN THIS PROCEDURE IS EMPLOYED, A CLOSE CHECK MUST BE MAINTAINED ON FUEL BALANCE.

C. Unbalanced Fuel Load - Main Tanks

To correct for asymmetric Fuel loads in the four main tanks due to engine failure or uneven transfer of auxiliary tank fuel, proceed as follows:

No. 1,2,3 & 4 Fuel Selector Switches	TANK-ENGINE-MANIFOLD
Booster Pump Switches	ON and OFF as required to maintain fuel load symmetry

D. No. 5 Auxiliary Tank Booster Pump Failure (Low Pressure Warning Light ON)

In the event of failure No. 5 auxiliary tank booster pump, proceed as follows:

No. 5 Booster Pump A.C. Circuit-breaker (3)	Pull out
No. 5 and No. 7 Booster Pump Switches	ON

When fuel level in No. 7 auxiliary fuel tank has been reduced to approximately 1700 pounds.

No. 1,2,3 & 4 Manifold Shut-off Valve Switches	CLOSE
No. 2 Fuel Selector Switch	MANIFOLD-ENGINE
No. 7 Booster Pump Switch	OFF

EMERGENCY OPERATING PROCEDURES

When the indicated fuel content in No. 5 auxiliary fuel tank has been reduced to 360 pounds.

No. 2 Fuel Selector Switch	TANK-ENGINE
No. 5 Booster Pump Switch	OFF

Transfer remaining fuel from No. 7 auxiliary tank to main tanks symmetrically.

NOTE: No. 5 Booster Pump Switch controls booster pump and tank shut-off valve. By closing Nos. 1,2,3 and 4 manifold shut-off valves, the No. 7 booster pump pressurizes the manifold and No. 2 engine is fed from the pressurized manifold when No. 2 Fuel Selector Switch is placed to the MANIFOLD-ENGINE position. When No. 7 booster pump is switched off, No. 5 auxiliary tank fuel is fed directly to No. 2 engine by gravity and by the mechanically driven backing pump on No. 2 engine. The procedure can be used for all auxiliary tanks by selection of the appropriate valves and pumps. The procedure should be discontinued before the level of the fuel reaches the booster pump. With the airplane in level flight attitude the recommended fuel quantity indications for discontinuance are as follows:

Tanks 5 and 7	360 pounds
Tank 6	300 pounds

E. No. 5 Auxiliary Tank Shut-Off Valve Failure

Proceed as follows if, with the low pressure warning light out, no change is recorded on the No. 5 auxiliary tank fuel indicator after five minutes of operation or some lateral imbalance is felt after 10 minutes:

No. 5 Booster Pump Switch	OFF

When fuel level in No. 7 auxiliary tank has been reduced to approximately 1700 pounds (220 Imperial (262 US) gallons):

No. 1,2,3 and 4 Manifold Shut-off Valve Switches	CLOSE
No. 5 Manifold Shut-off Valve Switch	OPEN
No. 2 Fuel Selector Switch	MANIFOLD-ENGINE
No. 7 Booster Pump Switch	OFF

When the indicated fuel content in No. 5 auxiliary tank has been reduced to 360 pounds:

No. 7 Booster Pump Switch	ON
No. 5 Manifold Shut-off Valve Switch	CLOSE
No. 2 Fuel Selector Switch	TANK-ENGINE

Transfer remaining fuel from No. 7 auxiliary tank to main tanks symmetrically.

NOTE: With this procedure, fuel is drawn from No. 5 auxiliary fuel tank through the fueling valve into the manifold and through the No. 2 fuel selector valve by the suction of the mechanically driven backing pump on No. 2 engine. The procedure can be used for all auxiliary tanks by selecting the appropriate valves and pumps. The procedure should be discontinued before the level of the fuel reaches the float valve. With the airplane in level flight attitude the recommended fuel quantity indications for discontinuance are as follows:

Tanks 5 and 7	360 pounds
Tank 6	1060 pounds

F. No. 6 Centre Auxiliary Tank Booster Pump Failure

NOTE: The No. 6 centre auxiliary fuel tank is fitted with two fuel booster pumps. Either pump is capable of transferring the total quantity of fuel from the tank. Failure of both pumps will not be considered.

G. No. 6 Centre Auxiliary Tank Shut-Off Valve Failure

Proceed as follows if, with the low pressure warning light out, no change is recorded on the No. 6 auxiliary tank fuel indicator after five minutes of operation.

No. 6 Fuel Booster Pump Switch	OFF
No. 2 or No. 3 Fuel Selector Switch	TANK-ENGINE-MANIFOLD
No. 6 Manifold Shut-off Valve Switch	OPEN
No. 2 or No. 3 Fuel Selector Switch	MANIFOLD-ENGINE

After satisfactory operation of one inboard engine from No. 6 centre auxiliary tank has been established, it is permissible to feed the other inboard engine from that tank.

EMERGENCY OPERATING PROCEDURES

When the indicated fuel content in No. 6 auxiliary fuel tank has been reduced to 1060 pounds:

No. 2 and No. 3 Fuel Booster Pump Switches	ON
No. 2 and No. 3 Fuel Selector Switches	TANK-ENGINE
No. 6 Manifold Shut-off Valve Switch	CLOSE

Note: A fuel low pressure warning is to be expected toward the end of this type of fuel transfer. If this occurs, No. 2 or No. 3 fuel selector switches must be immediately placed to the TANK-ENGINE position.

H. No. 7 Auxiliary Tank Booster Pump Failure (Low Pressure Warning Light ON)

In the event of failure of No. 7 auxiliary tank booster pump, proceed as follows:

No. 7 Booster Pump A.C. Circuit Breaker (3)	Pull Out
No. 5 and No. 7 Booster Pump Switches	ON

When the fuel level in No. 5 auxiliary fuel tank has been reduced to approximately 1700 pounds:

No. 1,2,3 and 4 Manifold Shut-off Valve Switches	CLOSE
No. 3 Fuel Selector Switch	MANIFOLD-ENGINE
No. 5 Booster Pump Switch	OFF

When the indicated fuel content in No. 7 auxiliary fuel tank has been reduced to 360 pounds:

No. 3 Fuel Selector Switch	TANK-ENGINE
No. 7 Booster Pump Switch	OFF

Transfer remaining fuel from No. 5 auxiliary tank to main tanks symmetrically.

EMERGENCY OPERATING PROCEDURES

NOTE: No. 7 booster pump switch controls the pump and tank shut-off valve. By closing No. 1,2,3 and 4 manifold shut-off valves, the No. 5 booster pump pressurizes the manifold and No. 3 engine is fed from the pressurized manifold when No. 3 fuel selector switch is placed to the MANIFOLD-ENGINE position. When No. 5 booster pump is switched off, No. 7 auxiliary tank fuel is fed directly to No. 3 engine by gravity and by the mechanically driven LP fuel pump on No. 3 engine.

I. No. 7 Auxiliary Tank Shut-Off Valve Failure

Proceed as follows if, with the low pressure warning light out, no change is recorded on the No. 7 auxiliary tank fuel indicator after five minutes of operation or some lateral imbalance is felt after 10 minutes.

No. 7 Booster Pump Switch	OFF

When fuel level in No. 5 auxiliary tank has been reduced to approximately 1700 pounds:

No. 1,2,3 and 4 Manifold Shut-Off Valve Switches	CLOSE
No. 7 Manifold Shut-Off Valve Switch	OPEN
No. 3 Fuel Selector Switch	MANIFOLD-ENGINE
No. 5 Booster Pump Switch	OFF

When the indicated fuel content in No. 7 auxiliary tank has been reduced to 360 pounds:

No. 5 Booster Pump Switch	ON
No. 7 Manifold Shut-Off Valve Switch	CLOSE
No. 3 Fuel Selector Switch	TANK-ENGINE

Transfer remaining fuel from No. 5 auxiliary tank to main tanks symmetrically.

NOTE: Fuel is drawn from No. 7 auxiliary fuel tank through the fueling valve into the manifold and through the No. 3 fuel selector valve by the suction of the mechanically driven LP fuel pump on No. 3 engine.

EMERGENCY OPERATING PROCEDURES

J. Fuel Dumping

CAUTION: DUMP FUEL IN CLEAR AIR IF POSSIBLE. AVOID RETURN FLIGHT THROUGH THE DUMPING AREA AND REFRAIN FROM SMOKING. (NOTE): IF AN ENGINE HAS BEEN SHUT DOWN DUE TO FIRE, AND FIRE NOT ABSOLUTELY CONFIRMED OUT, CONSIDER OVERWEIGHT LANDING

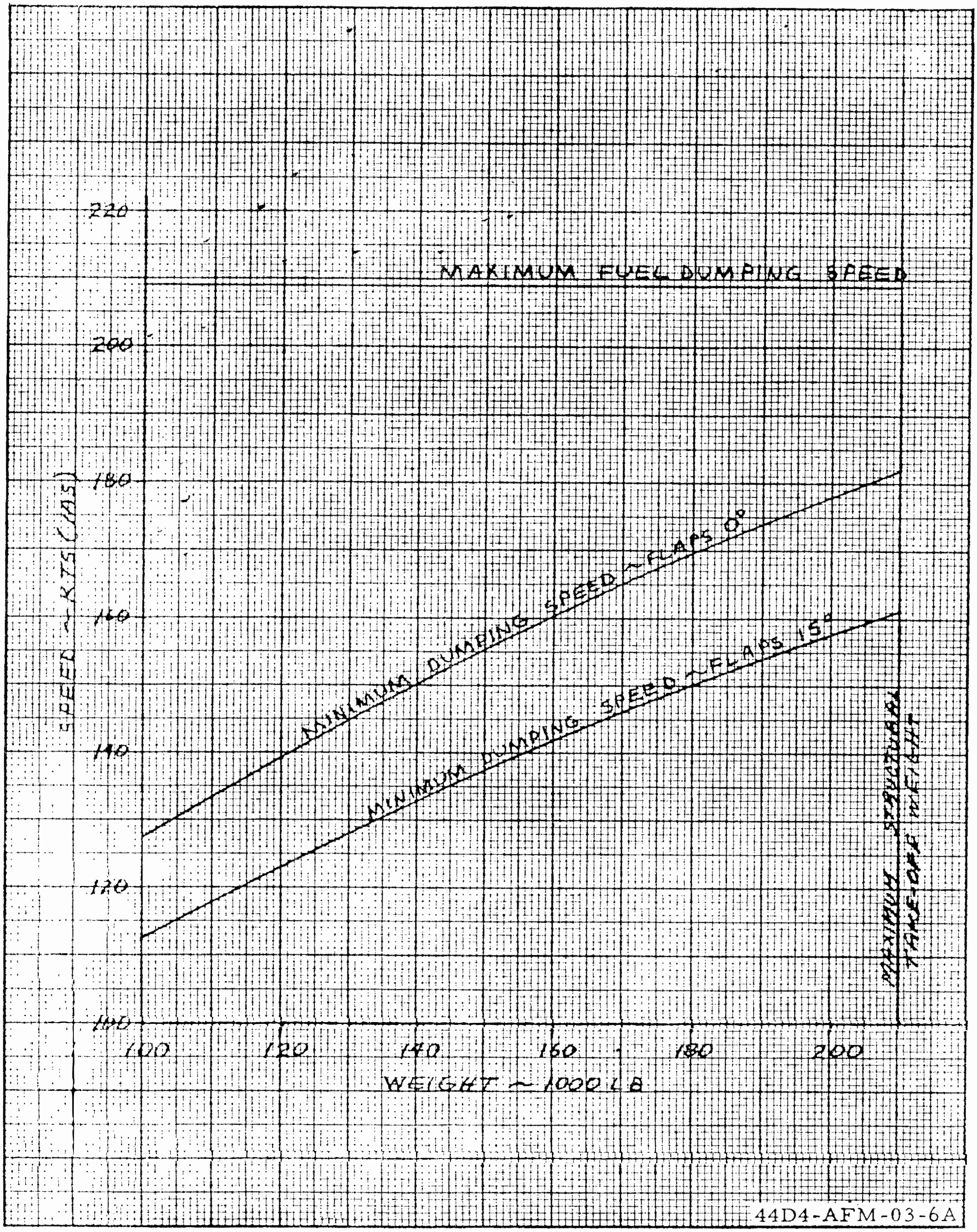
Landing Gear	UP
NOTE: If, through a malfunction, the landing gear must be DOWN while dumping fuel, use 15° of flap and maintain level flight.	
Flaps (in climb attitude with one or more engines inoperative)	15°
Flaps (all other flight conditions)	0° ot 15°
Anti-collision lights	OFF
Airspeed	Ref. Fig. 2
Radio Equipment	ON - Switch off HF
Horizontal Stabilizer Anti-ice Heaters	OFF
Elevator Horn Anti-icing (2)	OFF
No. 1,2,3 and 4 Fuel Selector Switches	TANK-ENGINE
NOTE: Fuel selector switch for inoperative engine	Leave in TANK-MANIFOLD

Transfer fuel from the No. 5,6 and 7 auxiliary tanks as follows:

No. 5,6 and 7 Booster Pump Switches	ON
No. 1,2,3 and 4 Manifold Shut-off Valve Switches	OPEN
Fuel Dump Switches (2)	ON
Fuel Gauges	Check symmetrical flow

When the required amount of fuel has been dumped:

Fuel Dump Switches (2)	OFF
No. 5,6 and 7 Booster Pump Switches	OFF (as each auxiliary tank low pressure warning light comes on)



Fuel Dumping Speed Chart
Figure 2

EMERGENCY OPERATING PROCEDURES

No. 1,2,3 and 4 Manifold Shut-off Valve Switches	CLOSE
No. 1,2,3 and 4 Fuel Selector Switches	TANK-ENGINE-MANIFOLD

K. After Fuel Dumping

When fuel dumping is completed, carry out normal fuel management procedure to transfer fuel from the inboard to the outboard main tanks. Services discontinued for fuel dumping may be resumed ten minutes after the fuel dump switches have been placed to OFF, provided fuel odors were not detected during the dumping process.

NOTES: (1) With the aircraft in level flight, the fuel dumping standpipe will reserve approximately 96 gallons (U.S.) in each tanks No. 1 and No. 4 and approximately 270 gallons (Imp.) in each of tanks 2 and 3.

Above figures apply to 160,000 ZFW aircraft
Higher figures apply to 155,000 ZFW aircraft

(2) The dump chutes cannot be retracted in flight.

(3) If, through a malfunction, the landing gear must be DOWN while dumping fuel, use 15° of flap and maintain level flight.

L. Fuel Dump Chute Failure

Should one dump chute fail to operate, proceed as follows:

(1) Jettison fuel from the serviceable dump chute.

(2) Transfer fuel from the opposite wing, keeping a careful check on lateral control.

(3) Repeat the procedure as necessary.

CAUTION: WHEN TRANSFERRING FUEL FROM THE UNSERVICEABLE DUMP CHUTE SIDE, ENSURE THAT AN ADEQUATE RESERVE OF FUEL IS RETAINED ON THAT SIDE.

(4) Equalize fuel in the four main tanks.

M. Fuel Temperature Control System Failure

High and low fuel temperature warning lights are provided for each engine. The warning light circuits are connected to the Master Caution System and the Annunciator Panels.
If the High Fuel Temperature Warning Light illuminates, proceed as follows:

(1) Inch the oil cooler flap towards the open position by momentary applications of the oil cooler switch until the lowered oil temperature reduces the incoming fuel temperature and the light goes out.

(2) Monitor the oil temperature carefully for the remainder of the flight.

If the Low Fuel Temperature Warning Light illuminates, proceed as follows:

(1) Inch the oil cooler flap towards the closed position by momentary applications of the oil cooler switch until the raised oil temperature increases the incoming fuel temperature to where the light goes out.

(2) Monitor the oil temperature carefully for the remainder of the flight.

19. Emergency Operation of the Electrical System

A. Constant-Frequency AC System

Warning of the failure of any one constant-frequency AC generator will be given by the illumination of the amber BKR OPEN light of the failed generator. If the failed generator is No. 1 or No. 4, the adjacent green ALTERNATE BUS-TIE CLOSED light will illuminate also, indicating that the stand-by generator is feeding the bus. No action is required on the part of the crew other than attempting to reset the failed generator.

If two generators become inoperative due to causes other than a bus fault, the remaining generator will automatically feed both load buses. The load on the live generator must be regularly monitored to ensure that an over-load condition does not occur. 40.0 KVA continuous. 60.0 KVA 5 min. 80 KVA 5 sec.

EMERGENCY OPERATING PROCEDURES

(1) Bus Fault

A probable bus fault is indicated by the tripping of the circuit-breaker of No. 1 or No. 4 generator, followed by the tripping of the standby generator circuit-breaker and the opening of the alternate bus tie relay associated with the faulted bus. In such an event, proceed as follows:

(a) Place bus isolate switch to isolate the faulted bus, i.e., BUS A ISOLATE or BUS B ISOLATE.

(b) Check frequency and voltage of the standby generator and, if the readings are correct, reset the standby generator.

NOTE: Constant-frequency load bus A feeds the No. 2 DC power unit and load bus B feeds Nos. 1 and 3 DC power units. If a load bus has to be isolated due to a bus fault, the associated DC power units will become inoperative. The remaining power unit should be regularly monitored to ensure that an overload condition does not occur.

B. Variable-Frequency AC System

The text and procedures contained in the emergency operation of the constant-frequency AC system of this Section are also applicable to the variable-frequency AC system with the exception of the reference to DC power units. If there is a complete failure of the variable-frequency AC system, the majority of the electrical anti-icing services will be lost.

C. DC System

(1) Failure of the Input Power Supply to a DC Power Unit

Warning of a loss of input power to a DC power unit or failure of a DC power unit will be indicated by the ammeter reading zero. The unit should be isolated by placing the appropriate ON-OFF switch to "OFF" and checking main essential bus tie switch is on.

NOTE: Illumination of an amber NO INPUT light indicates that the related AC power relay is open. This indication is not necessarily received upon failure of input power and is not received upon power unit failure.

EMERGENCY OPERATING PROCEDURES

(2) Loss of All DC Power Units

The loss of all DC power units will leave the battery as the only source of DC power. The following essential services may be directly operated from the battery:

Master warning system
Fire detection and smoke indication
Fire extinguishing
Fuel jettison
Fuel selector and manifold shut-off valves
A.C. and D.C. power control
Landing gear control
Wing flap control
Intercom
Radio power
Windshield anti-ice control
Compass amplifier
Ignition booster
Navigation lights
Utility lights at the crew stations and main distribution panel
Check list lights and instrument floodlights

To conserve the battery for essential services, proceed as follows:

BATT-OFF-GPU Switch	BATT
Main/Essential Bus Tie Switch	OFF
D.C. Power Unit ON-OFF Switches	OFF
D.C. Main Circuit-Breaker Panel	All circuit-breakers open

Should any service from the D.C. main bus be required, the appropriate circuit-breaker(s) must be set and the main essential bus tie switch placed to ON until the operation is completed.

20. Emergency Operation of Pressurization and Air Conditioning System

A. Automatic Temperature Control Failure

If failure of an automatic temperature control unit occurs, manual control must be exercised by periodic toggling of the appropriate control. Switch to the MANUAL COOL or HEAT position until the desired temperature is attained.

B. Malfunctioning Air Conditioning Control Valve

The failure of an air conditioning valve may be determined by placing the cabin control switch to full MANUAL HEAT or COOL and observing the illumination of the valve indicator lights. If a light does not illuminate in its correct sequence within 30 seconds of the preceding light illuminating, the associated isolating switch should be placed to ISOLATE to permit an electrical by-pass. If the faulty valve is the cabin mixing valve, place the related switch to EMERGENCY.

C. Illumination of Air Turbine O/Heat Light

If an air turbine o/heat light illuminates, the trouble may be attributed to:

(1) No cooling effect across the secondary heat exchanger caused by a broken duct.

(2) Failure on the ground of the nacelle ground blower valve in the closed position.

If the light illuminates on the ground, place the cabin control switch to MANUAL HEAT until the light goes out. If this action is unsuccessful within 15 seconds, the associated engine must be shut down.

If the light illuminates in flight, place the cabin control switch to MANUAL HEAT until the light goes out. Should this action fail to correct the overheat condition within 15 seconds, the related supercharger switch must be placed to SPILL.

21. Emergency Depressurization

Manual Cabin Pressure Control	DECREASE PRESSURE
Pneumatic System	STANDBY

EMERGENCY OPERATING PROCEDURES

Above 13,000 feet, a limited amount of pressurization will be maintained due to the outflow valves remaining closed under the action of the cabin altitude limit control. If complete depressurization is required, descend to a flight altitude below 13,000 feet.

A. Illumination of Cabin Altitude Exceeded Light

If the cabin altitude exceeded light illuminates and a check shows that the pressurization controls are in the normal positions and that the cabin altitude reading is too high, proceed as follows:

(1) Turn manual controller knob to INCREASE PRESSURE.

(2) If the desired cabin altitude cannot be achieved, the crew to breathe oxygen or descent to a flight altutude which will maintain a satisfactory cabin altitude with existing cabin differential pressure.

B. Illumination of Cabin Diff. Press. Exceeded Light

If the cabin diff. press. exceeded warning light illuminates, and a check shows that the pressurization controls are in the normal positions and that the cabin differential pressure reading is too high, proceed as follows:

(1) Turn manual controller knob to DECREASE PRESSURE.

(2) In the unlikely event of this action failing to correct the condition, place both superchargers to spill and commence letdown procedure.

C. Complete Pressurization Supply Failure (Both Superchargers Inoperative)

If complete failure of pressurization supply occurs, proceed as follows:

Descend to safe altitude	
Manual Cabin Pressure Control	DECREASE
Crew to breathe oxygen (if necessary)	
Place Cabin Air Valve	CLOSED (to divert all ventilating ram air to the cockpit)

D. Sudden Decompression

Proceed as follows:

(1) Crew to breathe 100% oxygen.

(2) Start low speed emergency letdown procedure to a safe altitude.

(3) Carry out emergency depressurization procedure.

A. High Supercharger Airflow

If the supercharger airflow indication is beyond safe limits:

Supercharger switch	SPILL

If the airflow fails to reduce:

Hydraulic system	LOAD
Supercharger switch	DISCONNECT

22. Emergency Operation of Anti-icing and De-icing System

A. Propeller and Cowls De-icing

If ice is forming on the aircraft and the engine de-icing systems have not been activated, the following de-icing procedure is to be used to ensure against the possibility of more than two engine flame-out being caused by ice ingestion.

Engine Selector Switch	ALL
Ignition Switch	Continuous (to provide ignition)
Engine Guide Vane De-icing Switch	ON NORMAL
Props and Cowls De-icing Switches	NORMAL (Engines No. 1 & No. 3) OFF (Engines No. 2 & No. 4)
De-icing Timer Switches	FAST or SLOW (Slow below -8°C) MAIN NORMAL

EMERGENCY OPERATING PROCEDURES

Ice Protection Master Switch	ON
Wait 1 minute then: Props and Cowls De-icing Switches	NORMAL (Engines No. 2 & No. 4)
Wait 1 further minute, then Ignition Switch	OFF

If descending into conditions where the indicated air temperature is above -5° C, it is advisable to discontinue the descent until late selection drill has been completed.

CAUTION: IF POWER PLANT DE-ICING IS LOST DURING FLIGHT IN ICING CONDITIONS, ENGINE MALFUNCTION OR EXCESSIVE PROPELLER VIBRATION MAY NECESSITATE SHUTTING DOWN THE AFFECTED ENGINE. EXCEPT IN AN EMERGENCY, NO ATTEMPT SHOULD BE MADE TO RESTART A STOPPED ENGINE AFTER FLIGHT IN ICING CONDITIONS UNTIL THE POWER PLANT HAS BEEN CLEARED OF ALL VISIBLE ICE.

If failure is indicated on the PROPS and COWLS PARTIAL FAILURE amber warning lights for Engine 2 and is followed by tripping of Variable Frequency Generator 1, the following procedure is to be followed:

Props and Cowls De-icing Switch ENG 2	OFF
V.F. Generator 1 Control Switch	RESET

Monitor the affected engine for loss of power and roughness.

NOTE: The same procedure applies for ENG 1 and Generator 4 respectively. If standby Generator 3 has taken over for either Generator 1 or 4 prior to the failure indication, read Generator 3 for 1 or 4 as necessary.

B. Wing Anti-icing

Failure of the automatic temperature control in any zone will be indicated by an associated skin temperature deviation from the normal operating range. Temperature control may then be exercised by using the appropriate control switch in the MANUAL HEAT or COOL and OFF positions in conjunction with temperature indicator monitoring. Illumination of a STRUCTURE OVERHEAT warning light will also indicate automatic temperature control failure. If manual control fails to alleviate the overheat condition, the illuminated light must be depressed to cause immediate closing of the respective modulating

EMERGENCY OPERATING PROCEDURES

valve is seized and will not close, in which case power on the appropriate engines must be reduced.

On initial selection of wing anti-icing, the heat rise may cause the structure overheat warning light to illuminate. This condition is acceptable on first heat application, provided the system stabilizes without further overheat warning after performing the following actions:

(1) Check that the temperature indicator is reading high (in red band) to confirm that the overheat switch is not malfunctioning.

(2) Hold the appropriate control switch to MANUAL COOL for thirty seconds and return to NORMAL.

(3) Check that the temperature reading drops and that the overheat warning light goes out.

23. Horizontal Stabilizer Anti-icing System Combustion Heater
(Use only if strictly necessary under heavy icing conditions)

A. Failure to Start

If heater fails to start, proceed as follows:

Heater Control Switch	OFF

Allow 1 minute for scavenging of fuel in the combustion chamber, then:

Heater Control Can Switch	EMERG
Heater Control Switch	NORMAL

If start is unsuccessful

Heater Control Switch	OFF

Allow 1 minute for scavenging of fuel in the combustion chamber, then:

Heater Ignition Switch	ALTERNATE
Heater Control Switch	NORMAL

If start is unsuccessful

Heater Control Switch	OFF

EMERGENCY OPERATING PROCEDURES

Allow 1 minute for scavenging of fuel in the combustion chamber, then:

Heater Control Can Switch	NORMAL
Heater Control Switch	NORMAL

If start is unsuccessful

Heater Control Switch	OFF

Allow 1 minute for scavenging of fuel in the combustion chamber, then:

Heater Control Switch	O/RIDE

If the heater still does not start, repeat the previous procedures with the heater control switch in O/RIDE.

NOTE: When the heater is operating in O/RIDE, use manual control to maintain normal operating temperature range. Also, to shut down heater when operating in O/RIDE, select heater control switch to OFF.

B. Illumination of Heater Overheat Light

If a HEATER OVHT light illuminates intermittently, the associated heater will be cycling on and off and in this event no action is required other than monitoring the temperature indicator. If, however, the light illuminates steadily, the heater control switch must be placed to OFF.

C. Malfunctioning of Automatic Temperature Control System

Malfunctioning of automatic temperature control system will be indicated by the temperature indicator needle being above or below the normal operating range. Should this happen, manual control of the heater must be exercised by using the O/RIDE and OFF positions of the heater control switch in conjunction with temperature indicator monitoring.

D. Complete Heater Failure

If an operating heater fails completely as evidenced by a loss of temperature indication on the indicator, the unit must be switched off and the failure to start procedure be carried out as described in the preceding paragraphs.

24. Windshield Failures

Figure 2A presents procedures to be followed in the event of in-flight fracture of one or more glass panes, or in-flight failure of the electrical heating system, for any of the panels in the crew compartment.

EMERGENCY OPERATING PROCEDURES

Description of Damage	Panel Affected	
	Centre, Main or DV	Rear
1 Arcing or electrical power failure	Switch off electrical power to panel. Restrict airspeed to 200kts below 10,000 feet	Switch off electrical power to panel.
2 Breakage of outer glass ply	As in 1	No restriction
3 Breakage of centre glass ply	No restriction	No restriction
4 Breakage of inner glass ply	No restriction	Switch off electrical power to panel
5 Breakage of outer and inner glass plies	Switch off electrical power to panel. Restrict airspeed to 200kts below 10,000 feet	As in 4
6 Breakage of outer and centre glass plies	As in 5	No restriction
7 Breakage of centre and inner glass plies	Switch off electrical power to panel. Reduce cabin differential to zero. Restrict airspeed to 200kts below 10,000 ft	Switch off electrical power to panel. Reduce cabin differential to zero.
8 Breakage of all three glass plies	As in 7	As in 7

Operational Procedures for In-flight Windwhield Failures
Figure 2A

EMERGENCY OPERATING PROCEDURES

25. Elevator Artificial Feel System Malfunction

Malfunction of the artificial feel system will be evidenced either by a decrease in control force accompanied by illumination of the ELEV. ART. FEEL window of the annunciator panel, or by an increase in elevator control force which, in the extreme case, may be sufficent to immobilize the elevator control. For either condition disengage the auto pilot followed by the selection of the feel simulator disengage control to OUT.

CAUTION: WHEN ARTIFICIAL FEEL IS DISENGAGED, CARE MUST BE EXECISED TO AVOID SUBJECTING THE AIRFRAME TO EXCESSIVE LOADS THROUGH OVERCONTROLLING.

26. Wing Spoiler System Malfunction

Warning of a spoiler overtravel condtion will be given by the flashing of the amber master caution lights and the illumination of the SPOILER O/SHOOT windows of the annunciator panels. The system may be reactivated by placing the wing spoiler switch, on the pilots overhead panel, to OFF and then to ON. If normal operation cannot be restored or any other malfunction exists, the system must be switched off for the remainder of the flight.

27. Emergency Operation of the Autopilot

A. Autopilot Failure Warning

If an AUTOPILOT FAIL warning is indicated on the annunciator panel, the autopilot will automatically disengage.

Following an AUTOPILOT FAIL warning, the autopilot disengage procedure described in Section 2 should be carried out.

B. Altitude Losses

The altitude lost following an elevator hardover malfunction are listed below. These altitude losses were determined with recoveries initiated after 3 seconds in the level flight configuration and after 1 second in the approach configuration, and with recovery carried out within the allowable G limits of the airplane.

CONFIGURATION	SPEED	ALTITUDE LOSS
Cruise, flaps 0°	V_{MO}/M_{MO}	110 feet
Approach, flaps 30°	$1.4\ V_S$	65 feet

28. Interior Fuselage Fires

A. Fire in the Horizontal Stabilizer Heater will be indicated by the HORIZ STAB fire warning light on the systems operators empennage fire control panel and by the STAB HTR FIRE window on the annunciator panels. The master warning lights will also illuminate and the warning bell will sound.

B. Horizontal Stabilizer Heater Fire Extinguishing

ARMED/NORMAL/TEST Switch	ARMED
Extinguisher Discharge Switch	DISC (discharge position)
Heater Switch	OFF

Vacate icing area as quickly as possible.

C. Cabin Smoke Detection

On SW, FT and SL aircraft, to check for fire in the main cabin, depress the PUSH TO DETECT button, and check for smoke indication in the indicator windows.

D. Cabin Fire Extinguishing

To extinguish a fire indicated in any of the smoke indicator windows 1-6:

Both Supercharger Switches	SPILL
Cabin Air Valves Switch	CLOSED
Manual Cabin Pressure Control	DECREASE PRESSURE

On all aircraft, to extinguish a fire in the radio rack, pull the following circuit-breakers on the main distribution panel:

D.C.	Inter comm A	Essential bus B
	Inter comm B	Main bus
	Radio Power A	Essential bus B
	Radio Power B	Main bus

A.C. (3 phase)

Radio Power A(3)	Constant-frequency Bus A Panel
Radio Power B (3)	Constant-frequency Bus B Panel
VOR 1 Instrumentation Unit (1)	Pilots Instrument Bus
VOR 2 Instrumentation Unit (1)	First Officers Instrument Bus

Extinguish the fire with the portable CO_2 fire extinguishers. Isolate the faulty component before energizing any of the equipment.

E. Smoke Evacuation

Before attempting to dissipate smoke accumulation, fire which is accessible should first be extinguished. When the air contains smoke or is otherwise contaminated, the crew should don oxygen masks and breathe 100% oxygen.

If the air conditioning system appears to be the source of smoke, determine which cabin supercharger is faulty by switching each to spill and back to normal alternately, leaving faulty one at spill.

If normal ventilation does not achieve satisfactory smoke evacuation in the cockpit, proceed as follows:

(1) Execute emergency descent to 14,000 feet or lower.

(2) Depressurize manually.

(3) Slow aircraft to 170 knots LAS.

(4) Close cockpit door.

(5) When aircraft differential pressure is zero, open escape hatch in roof in order to clear cockpit of smoke.

(6) Keep DV windows closed.

If the normal ventilation does not achieve satisfactory smoke evacuation in the cabin, ventilation rate may be increased by depressurizing. Proceed as follows:

(1) Execute emergency descent to 14,000 feet or lower.

(2) Depressurize manually.

NORMAL OPERATING PROCEDURES

General

The purpose of this section of the manual is to establish procedures which are to be used during normal operation of the Company's CL44 aircraft.

A complete knowledge and understanding of current procedures will contribute to a smooth and efficient operation. It is likely, however, that situations will arise for which no procedure has been evolved or modification of an existing procedure will be called for. In such case it is expected that each crew member will exercise good judgement with safety of flight his prime consideration.

Crew Coordination

The Captain may assume that unless he orders to the contrary each crew member will carry out his duties as laid down in this section and so, no detailed briefing about such duties should be necessary in normal circumstances. However, if the Captain wishes to depart from the standard, he is responsible for ensuring that each member of his crew has a clear understanding of his requirements during such a departure. In particular he should advise the First Officer or Flight Engineer if, in the case of malfunction he intends to abandon take-off at a speed in excess of V_1.

It must be clearly understood that it is each crew member's duty to monitor all procedures and draw the Captain's attention to any departure from the normal. In this respect cross-checking of flight instruments and setting, safety heights, altimeters and settings, courses and speeds are vital to overall safety and efficiency. By this means mistakes can often be prevented and more serious incidents avoided.

In order to avoid error or misunderstanding and to give time to correct a misinterpreted or mistimed order, all commands on the flight deck must be repeated back clearly BEFORE taking the required action, and again when the action is completed. In all phases of flight, training and proficiency checks, Captains and First Officers will, at all times, demonstrate judgement commensurate with experience required of a pilot in Command. The ingenuity of the pilot will be taken into consideration in the application of any procedure. The importance of good flight deck management cannot be over emphasized.
In the interest of complete crew coordination, ALL THREE crewmembers will wear their headsets.

Coordination and Use of Check Lists

It is the Captain's responsibility to call for all appropriate check lists at the proper time. However, when the First Officer is manipulating the controls, he will be expected to call for the Check List when it should be used. The check lists are used so that the flight crew will not need to rely upon memory for items to be checked. The items are to be accomplished one at a time.

The "CHALLENGE" items will be read in an audible clear voice and the "RESPONSE" will be made audibly clear before proceeding to the next item.

The First Officer will read the challenge items of the before start, after starting, and park check list. The Flight Engineer will read all other challenge items.

The Captain is responsible for, but may delegate the Flight Engineer to conduct, a preflight inspection of the aircraft.

Where a more detailed expansion of any preflight or check list item is deemed necessary, such expansion will be found in this section.

Preflight Instructions

Preparation of flight plan, weight and balance, and study of the weather and all factors relating to the safe and expeditious conduct of the flight will be a joint undertaking between the crew and operations personnel where available.

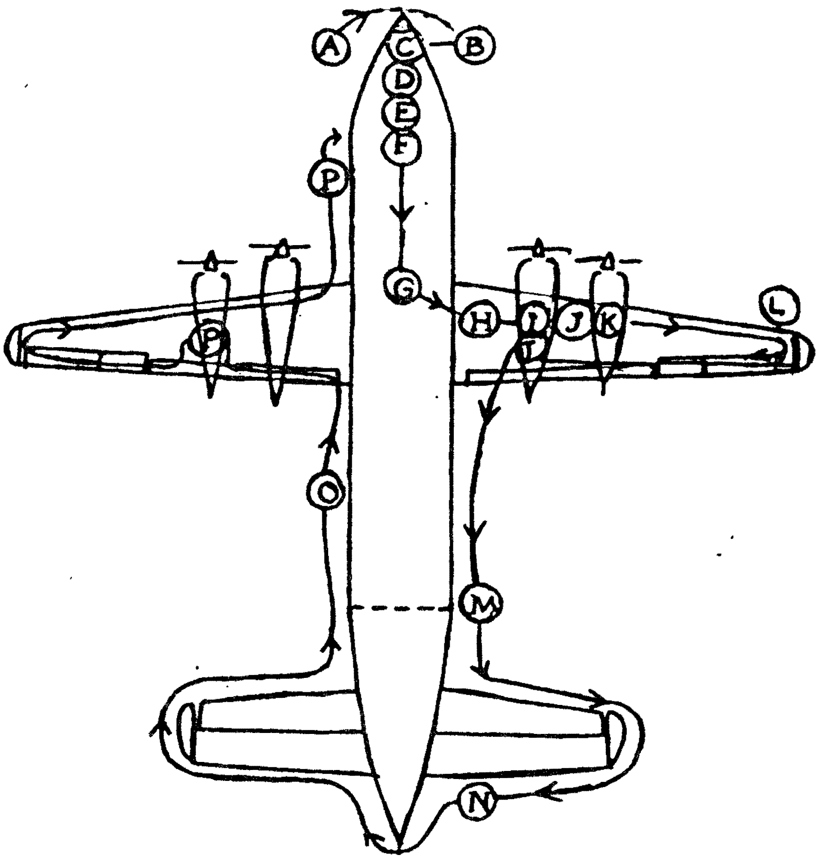
First Officer

The First Officer will report to flight operations and will gather pertinent information regarding the flight:

1. FILE FLIGHT PLAN: OBTAIN WEATHER FOR PLANNED ROUTE AT LEAST ONE HOUR BEFORE ETD.
2. VERIFY WEIGHT AND BALANCE FORMS.
3. MAKE OUT SPEED CARD.
4. GATHER ALL FLIGHT DOCUMENTS FOR CAPTAIN'S SIGNATURE:
    - A. CARGO MANIFEST
    - B. GENERAL DECLARATION
    - C. FLIGHT PLAN FORMS
    - D. WEIGHT & BALANCE
    - E. TELECOPY OF WEATHER IF AVAILABLE
    - F. SPEED CARDS
    - G. JEPPESEN MANUALS
    - H. FOR INTERNATIONAL FLIGHTS - PASSPORTS
    - I. FLIGHT LOG

Flight Engineer

The Flight Engineer will report to operations and obtain the required fuel and other pertinent information regarding the flight. He will then proceed to the aircraft as soon as possible to acquaint himself with the items of the technical log, including a review of the carried forward defects and aircraft release form, properly signed. At terminal and main base stations a more extensive preflight inspection is required than at any intermediate stop. A preflight should be completed to allow the crew to be at their stations 15 minutes prior to departure time.



I. EXTERIOR CHECK

A visual preflight exterior check will be made by the Flight Engineer prior to departure in accordance with the items listed on pages 3 through 12.

During the check, particular attention will be given to security of all tank caps and access panels; damage to the skin; damage to and fit of doors, windows and hatches.

1) ENSURE GROUND POWER SWITCH..................................OFF

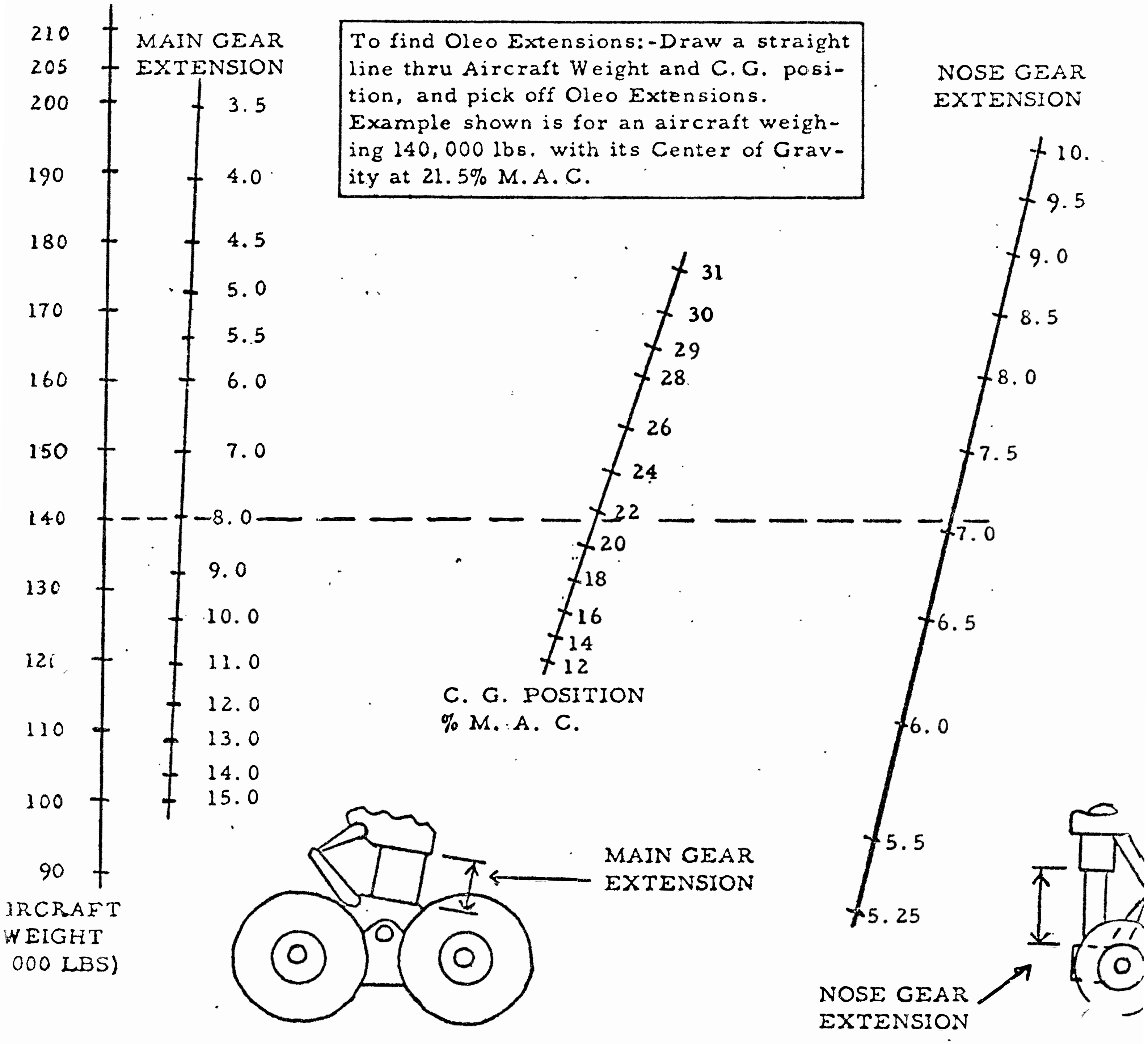
2) CHOCKS IN PLACE..CHECKED

3) AREA CLEAR OF LOOSE OBJECTS...............................CHECKED

A. L.H. FRONT NOSE AREA

1. Pitot cover...Removed
2. O.A.T. probe pitot head (alignment)(outboard pitot head to Captain's instruments-inboard to artificial feel, wing spoiler differential switch and flight recorder...Condition

Allowable Deviation ± 3/4'



To find Oleo Extensions:-Draw a straight line thru Aircraft Weight and C.G. position, and pick off Oleo Extensions. Example shown is for an aircraft weighing 140,000 lbs. with its Center of Gravity at 21.5% M.A.C.

MAIN AND NOSE GEAR EXTENSION NOMOGRAM

Figure 1

3. Static vents, 4 holes....................................Clear
4. L.H. nose inspection panel...............................Open & Inspect Area
5. G.P.U. ground connection.................................Connected
6. Artificial feel drain line...............................Clear
7. Ice detector sensing holes...............................Clear
8. Radome latches (4).......................................Latched

B. R.H. FRONT NOSE AREA

1. Static vents, 4 holes....................................Clear
2. Pitot cover..Removed
3. O.A.T. probe pitot heads - (outboard to co-pilot's instruments, navigator's instruments and auto-pilot air data sensor. Inboard pitot head common TEE with L.H. inboard pitot head)..........................Condition
4. Pressurization sensing hole (top hole)...................Clear
5. Smoke detector outlet (lower hole).......................Clear

C. NOSE WELL AREA - FORWARD NOSE GEAR DOORS

TO BE OPENED BY GROUND CREW

1. Nose gear pins (holes for 2 gear pins, check 2 pins...Installed
2. Artificial feel reservoir, quantity 1 gallon..........Cap Safetied
3. Artificial feel drain valve............................Off
4. Artificial feel air charging valve (reservoir press position)..Wire Locked ON
5. Artificial feel damper accumulator valve (press release valve)...Normal
6. Artificial feel signal pressure........................20 psi + 10%
7. Artificial feel signal pressure........................37 to 43 psi
8. Artificial feel pump pressure..........................500 psi + 10%
9. Artificial feel motor, pump and accessory..............Condition
10. Pitot drain lines.....................................Capnuts ON
11. Brake control and reducing valve......................No leaks
12. Brake accumulator manual air charge...................Front 1750 psi
Rear 1750 psi
13. Brake accumulator manual air charging valves 2 (Spring latched closed) - Shut 90° to line............Closed
14. Nose area press floor panels (2 panels)...............Locked
15. Nose gear uplock and micro switch.....................Condition
16. Nose gear down lock...................................Closed
17. Down lock bungee cans (2).............................Check Position on edge of rig hole
18. Nose gear doors.......................................Connected

D. NOSE LANDING GEAR

1. Nose wheel...Centered
2. Nose gear strut..Condition and extension
3. Towing disconnect (check lock pin and plunger in detent..Engaged

4. Cam tracks and switches..............................Condition
5. Tires..Condition
6. Ground static wires..................................Installed

E. FORWARD LOWER FUSELAGE

1. External power connected.............................Phase sequence light out
2. Battery drain and vent...............................Clear
3. Outflow valve screen.................................Clear

F. FORWARD LOWER BAGGAGE COMPARTMENT

1. Battery..Connected
2. Forward baggage area.................................Cargo secured
   Service lights out
   Door locked

G. FRONT SPAR COMPARTMENT

1. Main gear emergency air pressure.....................3000 psi (Nominal)
2. Pneumatic pack.......................................Condition
3. Variable frequency circuit breaker panel..............Breakers In
4. General area fuel fumes or leaks.....................Checked
5. Torque tubes...Condition
6. Access door (area vent in door)......................Condition and security
7. Anti-collision light.................................Condition
8. Antennas...Condition

H. R.H. INNER STUB WING

1. Leading edge drain...................................Clear
2. Access panels..Secure
3. Overwing tank caps & panels (No. 6)..................Secure

I. NACELLE #3

1. Cowling (left side 5 latches right side 6 latches)....Secured
2. Air intake and exhaust scoops........................Clear
3. Propeller in BETA range-Turn prop 4 blades check leading edges, engine noise and binding. A.D.L.S. propeller
4. Drains...Clear
5. Auxiliary gear box oil cooler air outlet..............Clear
6. Engine oil cooler inlet and outlet...................Clear
7. Oil cap and service door.............................Secured
8. Turbo fan..Free

J. R.H. INTER NACELLE WING AREA

1. Leading edge area drain..............................Clear
2. Dip stick reading....................................Record & stow
3. Tank cap & panel (#3)........(Secure if used).........As required
4. Jet pipe access panels nac. 3 & 4.....................Secure

K. NACELLE #4

Repeat above items in "I"

1. CSD tank cap...Secure
2. Panel and anti-icing exhaust flaps....................Condition

L. R.H. WING

1. Wing leading edge and drain...........................Condition
2. Wing illumination light O.B. #4 nacelle...............Condition
3. Drip stick readings...................................Record & secure
4. Overwing tank caps & panels...........................Secure
5. Stall warning (free)..................................Condition
6. Wing tip and navigation light.........................Condition
7. R.H. aileron and tabs.................................Condition
8. Static discharge wicks................................Condition
9. Landing light...Condition
10. Wing tank fuel vents.................................Clear
11. Tail pipe and breather discharge (#4)................Clear
12. Collector tank discharge pipe........................Secure & clear
13. Firex discs - 2 yellow - 1 red.......................Condition
14. Refueling panel
    a) Manifold selector switches........................OFF
    b) Pre-check selector switch.........................OFF
    c) Manifold cap......................................Installed & secure
    d) Access panel......................................Closed
15. Outer wing flap......................................Condition
16. Fuel jettison door...................................Flush
17. Jettison valve drain (rubber hose drain through inspection panel)...........................No leaks
18. Wing tank fuel vents.................................Clear
19. R.H. main gear
    a) Sequence valve....................................Freedom of operation
    b) Actuator attachments at wing spar.................Condition
    c) Emergency uplock actuator.........................Retracted
    d) Uplock actuator claw..............................Open
    e) Main gear doors...................................Condition
20. Strut extension......................................Check
21. Tires wheels and brakes..............................Condition
22. Flight control rods..................................Condition
23. Anti-skid control valve (no leaks)...................Condition
24. Tail pipe and breather discharge #3..................Clear
25. Inner wing flap......................................Alignment & condition

M. R.H. REAR FUSELAGE

1. Ground air condition access panel....................Closed
2. Rear baggage area....................................Cargo secured
   Service lights out
   Door locked
3. Outflow valve, screen................................Clear
4. Fairing over swing tail hinge........................Condition

N. TAIL AREA

1. Stabilizer leading edge and elevator horn.............Condition
2. Control surfaces and tabs condition..................Checked
3. Static discharge wicks...............................Condition
4. Navigation lights....................................Condition
5. Horizontal stabilizer heater exhaust (no fuel indication)..Clear
6. Tail heater firex discharge discs (1 yellow - 1 red)..Condition
7. Tail inspection panels (6)...........................Secured
8. Rear cargo inspection entrance door..................Closed
9. Swing tail break.....................................Check condition
10. From tail examine aircraft fuselage for general condition, including sign of scrape marks on lower end of fuselage.

O. L.H. REAR FUSELAGE

1. Outflow valve and screen.............................Clear
2. Pressurization static sensing........................Clear
3. ADF antennas...Condition
4. #6 tank cavity vents.................................Clear
5. Rear spar fuel drains................................Clear

P. L.H. WING

1. Repeat H, J, K, and L where applicable
2. Main hydraulic tank #1 aft nacelle (quantity placard for proper level)......................................Cap secured
3. Main hydraulic tank air pressure.....................12 to 14 psi
4. Main accumulator air charge..........................2000 psi
5. Pneumatic air selector valve.........................Reservoir & press. pos.
6. Tank drain valve.....................................Closed
7. Unloading valve (load position plunger) red line......Out
8. Hydraulic test stand connections (2).................Capped
9. C.S.D. oil cooler shutters...........................Condition
10. C.S.D. oil cooler intake............................Clear
11. C.S.D. tank cap at #2 overwing fuel panel...........Secure
12. All exterior hatches................................Closed
13. From crew entrance door check tail heater inlet blanking door.......................................Open

II. INTERIOR INSPECTION - FLIGHT ENGINEER

A. CABIN

1.	Swing tail area	Condition
2.	Fin scoop blanking plug control	"Open" (C.W.) light Out
3.	Swing tail locks	Checked (8) lock pins
4.	Flight control rods	Free condition
5.	Floor hatch	Closed
6.	Swing tail switches	Off
7.	Swing tail hydraulic line	Stowed
8.	Cargo	Condition & secured
9.	Emergency exit doors	Closed & locked
10.	Forward cargo door and escape rope	Handles up pins & hooks locked
11.	Door open test switch panel	Checked - light out
12.	Forward toilet	Condition

B. EQUIPMENT CHECK

1.	Ditching rope	Checked
2.	Crew ditching hatch	Closed
3.	Spare fuses and bulbs	Checked
4.	Fire axe	Checked & stowed
5.	Fire extinguishers	Checked & stowed
6.	First aid kit	Checked & stowed
7.	Life rafts and locator beacon	Checked & stowed
8.	Walk around bottle and mask	Checked & stowed
9.	All required logs and forms, flight manual, check lists	Aboard
10.	A.C. and D.C. electric power	As required
11.	A.D.L.S. warning light	Light on (cancel F. pump)
12.	Battery switch	On battery
13.	TRU's off	Check battery voltage
14.	Ground power voltage	Checked
15.	Circuit breaker panel	As required

C. OVERHEAD PANEL

1.	Auxiliary hydraulic pump (freight door power switch)	Pressurize system then off
2.	Brake pressure gauges	Pressure up
3.	Hand pump selector switch (de-energized)	L.G. position
4.	Main system hydraulic gauge	Check
5.	Hydraulic system pressure switch (de-energized)	Load position
6.	Pneumatic pressure (check standby 1 & 2)	Standby 1
7.	Propeller & cowl de-ice (ready & part fail lights)	Push to test

8. Propeller & cowl de-ice switched (4)..................Normal 1 & 3
   Off 2 & 4
9. De-icer timer select switch............................Fast & slow
10. De-icer timer test switch..............................Normal
11. De-icer timer unit select switch.......................Main & standby
12. I.G.V. switch..Off
13. Ice protection master switch...........................Off
14. Ice detector green light...............................Press to test
15. Scoops anti-icing ready and part fail lights..........Press to test
16. Scoops anti-icing switches (4).........................Normal
17. Fin intake and splitter (ready & part fail lights)....Press to test
18. Fin intake and splitter switch.........................Normal
19. Wing overheat lights (test button).....................Press to test
20. Surface temperature indicators.........................Check
21. Empennage over-heat lights.............................Press to test
22. Wing surface anti-icing switches (4)..................Normal
23. Empennage anti-icing switches..........................Normal
24. Fin scoop door W/L press to test.......................Out
25. Elevator horns anti-icing lights.......................Press to test
26. Elevator horns anti-icing switches (2)................Normal
27. Rudder jackbox heater..................................Off

D. CENTER PANEL

1. Lighting control panel.................................Check
2. Generator selector switch..............................G.P.U.
3. Frequency 400^{+15}_{-10}, Volts 115 ± 4.......................Check
4. Watt varmeter gauges (3)...............................Check zero
5. Generator circuit breaker switches (constant freq.)...Reset then normal
   1-2-4
6. Breaker open warning lights............................On 1-2-4
7. Alternate bus tie lights (2)...........................On
8. Bus isolate switch.....................................Isolate A then B
   then Normal
9. G.P.U. switch & light..................................On G.P.U.
10. Cabin smoke detector...................................Press to test
11. Cabin air valve switch.................................Guarded/Normal
12. Empennage fire arming switch...........................Test and Normal
13. Extinguisher discharge switch..........................Guarded/Off
14. Variable frequency volt selector No. I position.......Volts zero
15. Variable A.C. watt-varmeters (3)......................Check zero
16. Generator circuit breaker switches (var. freq.).......Trip 1-3-4
17. Generator breaker open lights..........................On 1-3-4
18. Alternate bus tie lights (2)...........................On
19. Bus isolate switch.....................................Isolate A then B
    & return to normal
20. TRU switches...On
21. TRU warning lights.....................................Out
22. TRU amp. gauges..Check for equal
    reading

D. CENTER PANEL (Cont'd)

23.	D.C. voltmeter	28± volt or zero
24.	Emergency bus tie switch	On

E. LOWER PANEL

1.	Cabin altitude & diff. pressure exceeded lights	Out
2.	Cabin & A/C altimeter - field elevation differential pressure	Zero
3.	Cabin rate of climb	Zero
4.	Cabin manual pressure selector	Full decrease
5.	Static & suction switches (2)	Guarded - Normal
6.	Cabin pressure rate control (approx. 300' per min.)	Align arrow
7.	Set barometric control	Field - barometric
8.	Set cabin altitude	Field elevation
9.	Supercharger airflow gauges	Zero
10.	Air turbine overheat lights (2) (Push to test)	Off
11.	Supercharger spill switch (2)	Normal
12.	Flight deck heat	Auto
13.	Temperature selector	As required
14.	Valve isolate switches (5)	Normal
15.	Cabin temperature selector	As required
16.	Cabin heat	Auto
17.	Cabin temperature gauge	Check
18.	Clock	Check & set
19.	Oxygen quantity (1500 psi min)	Check
20.	Oxygen regulator - test	Set 100%
21.	Fuel dump switches	Guarded & safetied Off
22.	Fuel quantity	Check & record
23.	Fuel selector valves (check sequence lights)	Tank to engine
24.	Fuel manifold valves	Closed
25.	Auxiliary boost pumps	Pumps on, check low pressure warn. light out. Then off
26.	Main boost pumps	On - low pressure warn. lights out.
27.	Intercom box	As required
28.	Hand pump manual selector	Main system wirelocked
29.	Hand pump handle	Stowed

III. PILOTS' COCKPIT PREFLIGHT CHECK

A. OVERHEAD PANEL

1.	Instrument lights	As required
2.	Gyro slaving controller	Slave "Mag" position
3.	ORD lights	As required

4. Flight recorder....................................Warning light checked
5. Spoiler..On & lights checked
6. Anti-skid system...................................On light out
7. Pre-stall warning..................................Test
8. Master warning.....................................Engineer's Preflight
9. Engine fire & tail pipe overheat...................Engineer's Preflight
10. Navigation, wing flood, anti-collision lights.........Checked as required
11. Indicator & warning lights............................As required - Day Bright Night Dim
12. Standby compass light.................................As required
13. Anti-dazzle light.....................................Off
14. Ignition selector switch..............................Off
15. Start selector switch..................................Off
16. Engine selector.......................................No. 1 Engine
17. Propellers control....................................Off
18. Cockpit voice recorder................................Checked
19. Pitot heaters...Checked & off

20. Windshield heat.......................................On low, indicato checked

Turn on windshield heat & check all indicators for operation.

Note 1: When actuating the windshield heat system during extremely hot temperature conditions, it is possible for the flag indicators to remain at an OFF indication if the panes are above the cycling temperature of 38°C (100°F), regardless of the position of the HIGH HEAT, LOW HEAT, GROUND TEST switch.

Note 2: When the temperature on the ground is 0°C or below, during the After Starting and Taxi Check select Windshield Heat to LOW for 30 seconds, then to OFF for 30 seconds. Repeat this cycle twice, then leave switch in LOW position for flight. This method prevents too sudden heating effect to glass panels which have been cold saturated and prevents arcing and possible shattering.

21. Radio and navigation system

    a. No. 1 ADF...Checked & set
    b. HF 1 & 2..Off
    c. No. 1 VHF...On & set
    d. No. 2 VOR transfer switch.........................Normal
    e. No. 1 & 2 VOR.....................................Checked & set
    f. RADAR MASTER SWITCH...............................Off
    g. Transponder.......................................Standby
    h. Co-pilot/navigator transfer switch................Co-pilot
    i. Marker beacon.....................................High

22. Check and set radios as required:

    a. Check operation of loop.
    b. Compare ADF bearings.
    c. Check VOR on test station or compare bearings.
    d. Check VHF and obtain current airport weather for departure from ATC Tower. Obtain a time check.
    e. Check & set HF frequency when required.
    f. Set Omega System.

OMEGA SYSTEM PREDEPARTURE CHECK

NOTE: To enter data on dual Omega system installations, see Dual Omega Installations in this section.

Power on (clears memory)

1) Pull out & turn Off/AMR switch from Off to A or M.

Perform lamp test

1) Turn to TEST.
2) Press CLR, 19, ENT. Lamps light, left display and program number appears in right display.
3) Press T. Lamps light, right display.
4) Press T. Statur/warning indicators and FR-TO lamps light. Program number appears in right display.

Enter date and time

1) Turn to D/GMT.
2) Key in month (01 - 12), day (01-31).
3) Press ENT.
4) Key in GMT (hours, minutes, seconds)
5) Press ENT.

Enter position

1) Turn to POS.
2) Key in N or S, then latitude coordinates, and E or W, then longitude coordinates.
3) Press ENT.

Enter waypoints (wpts)

1) Turn to WPT (WPT #1 will appear in left display)
2) Key in N or S, then latitude coordinates and E or W, then longitude coordinates for wpt #1.
3) Press ENT.
4) Complete entry of remaining wpts.

f. Set Omega System (Cont'd)

Verify waypoints

1) Go out of and back to WPT.
2) Verify wpt #1.
3) Press ⟶ and verify wpt #2.
4) Verify remaining wpts.

Verify flight plan

1) AMR switch to R.
2) Turn to DIS/CRS.
3) Observe "01" on FR-TO display. If not press TRK, CHG, 01, ENT.
4) Verify DIS/CRS for flight leg 01.
5) Press ⟶ and verify flight leg 12.
6) Verify remainder of flight plan.

AUTOPILOT INTERCONNECT CHECK

Autopilot check can only be performed if TAS is zero.

1) AMR switch to A.
2) Turn to TEST.
3) Key in CLR, 70, ENT.
4) Omega will command 15° right roll.
5) HSI will indicate ½ scale right crosstrack deviation.
6) External annunciator lamps and signals, as installed, will be ON. (SYSTEM STATUS, TK LEG CHANGE, TK CHANGE, DR, HSI VALID, VLF, TO/FROM = TO, STEERING VALID).
7) Press T.
8) Omega will command 15° left roll.
9) HSI will indicate ½ scale left crosstrack deviation.
10) External annunciator lamps OFF. (HSI INVALID, TO/FROM = FROM, STEERING VALID - ON)

Dual Omega Installations

1) Apply power and perform lamp test on each system independently with AMR switch set to A or M.
2) To enter date, time, position, and waypoints set the AMR switch to A or M on sending system, and set AME AMR switch to R on the receiving system.
3) Verify waypoints in each system independently with AMR switches set to A or M.
4) Verify flight plan in each system independently with AMR switch set to R.
5) Perform autopilot check on the system interconnected to the antopilot. If either system can be switched to the autopilot, perform autopilot check independently.
6) If date, time or present position was entered incorrectly, correct that entry on each system independently. To correct the error in the receiving system, set AMR switch to A or M.

f. Set Omega System (Cont'd)

NOTES:

1. After you entered position, HOLD lamp went out and then on. The ONS automatically turned on Ramp Protect. Ramp Protect instructs the computer not to use Omega/VLF signals to determine present position; the ONS still receives and processes Omega/VLF signals but does not use them to update position. While in the terminal area, this feature prevents electrical interference from causing erroneous reporting of present position. The ONS will automatically turn Ramp Protect off 12 seconds after lift-off. Tracor recommends you turn Ramp Protect off during taxi. To turn Ramp Protect off, press HLD; the HOLD lamp will go out.
2. If WARN lamp lights, follow procedures in EMERGENCY OPERATION.

23. Normal VHF/NAV setting

a. VHF 1	Company frequency
b. VHF 2	
Head A	Ground control frequency
Head B	Control tower frequency
c. ADF 1	Primary radio BCN
d. ADF 2	Outer marker or equivalent
e. VOR 1	Main VOR frequency (first check point)
f. VOR 2	ILS or VOR (Final approach fix)
g. Marker beacon	HIGH

NOTE: These are recommended Normal Settings and may vary at Captain's discretion.

B. CAPTAIN'S PANEL

1. Oxygen mask & regulator	Connected/emergency toggle switch test, then normal diluter switch - 100%
2. Windshield wiper	Off
3. Nose steering	Normal
4. Com/Nav. control box	Checked/intercom & hot mike knob "out", rotary switch on #2 VHF, Volume Control 9 o'clock
5. Wing spoilers	**Move yoke to the left,** note light will come off & on. Repeat operation to the right.

B. CAPTAIN'S PANEL (Cont'd)

6.	Air/ground lever switch	Ground
7.	Radar scope	Set range & tilt/OFF
8.	V.G. transfer switch	Checked & normal
9.	Compass system selector	Normal
10.	IDS comparator light	Checked
11.	Airspeed indicator/Mach warning	Set SL pointer to SL Vmo for nearest ZFW in the Vmo/Mmo limitations table on this manual or airspeed placard.
12.	Mach indicator	Checked
13.	Turn and bank indicator	Checked - no flags
14.	Approach horizon	

a. Check for Warning Flags (GS, LOC, Gyro, steering)
b. Set Heading Mode, move the Heading Selector on Course Indicator to the left and right so that the Heading Marker passes through the lubber line on the Course Indicator, and note that the Steering Pointer on the Approach Horizon follows the Heading Marker.
c. Switch ILS-Heading Mode Selector to ILS and note that the Glide Slope Pointer "jumps' for sensitivity and that the Steering Pointer does not follow the Heading Marker on the Course Indicator while moving the Heading Selector.
d. Set the Pitch Trim Control to Neutral.

15.	Course indicator	Set Course Indicator to desired Radial Set Heading Marker, check for Compass Warning Flags.
16.	Radio magnetic indicator	Checked & set
17.	Standby horizon	Set
18.	Vertical speed indicator	Checked
19.	Altimeter	Set
20.	Marker beacon lights	Checked

C. CENTER PANEL

1.	VHF NAV 1 & 2	Checked & set (See UHF/NAV Normal Setting)
2.	Altitude reminder	Set
3.	Dimmer switch	As required
4.	Omegas	Checked & set
5.	VHF Comm. #2	On (select frequency)
6.	IDLE throttle valve indicators	Low (4)
7.	Free air temperature gauge	Checked
8.	Clock	Set

9. DME indicator..Checked
10. Fuel flow indicators....................................Checked
11. Standby flow indicator switch...........................Normal
12. Landing & taxi lights...................................Press to test lights/set as required
13. Prop synch indicator....................................Checked
14. Engine Firex switches guards............................Safetied
15. Torque indicators.......................................Checked
16. LP RPM indicators.......................................Checked
17. TGT indicators..Checked
18. HP VRPM indicators......................................Checked
19. Oil press indicators....................................Checked
20. Cabin altitude warning light............................Checked
21. Flap indicator..Up
22. Auto pilot indicator....................................Checked
23. Cabin altitude indicator................................Checked
24. Beta lights...Press to test/ON
25. Oil cooler flaps..Auto or "Open"
26. Oil temperature indicators..............................Checked/Ambient
27. Landing gear..Down, warning light & horn checked
28. Landing gear emergency extension switch.................Guarded safetied
29. Elevator trim...Checked & set
30. Aileron & rudder trim...................................Checked & set
31. Auto pilot disconnect lever.............................Out
32. Air and ground lever....................................Ground
33. Flight control surfaces lever...........................Locked
34. Friction lock...As required
35. Condition levers..Fuel OFF
Power levers locked
Ground idle
36. Artificial feel...As required
37. Flap position lever.....................................Up (Obtain ground crew clearance prior to any flap selection.)
38. Auto pilot..Disengaged

D. FIRST OFFICER'S PANEL

1. IDS comparator warning...................................Checked
2. Standby Gyro...Normal
3. A/S mach warning indicator...............................Set & checked
4. Turn and bank indicator..................................Checked
5. Approach horizon...Checked
6. Course indicator...Checked
7. Radio magnetic indicator.................................Checked
8. Altimeter..Set
9. Marker beacon lights.....................................Checked
10. Clock...Set

E. SIDE PANEL - RIGHT

1.	Mach A/S warning & ZFW indicator	Set & checked
2.	Annunciator panel	Checked
3.	Radar scope	Checked & set
4.	Oxygen regulator	Connected/emergency toggle switch test, then normal diluter switch - 100%
5.	VHF control box	Checked & set
6.	Windshield wiper selector switch	Off
7.	Pitot static selector	Normal
8.	Check for proper Jeppesen Manuals, Normal and Emergency Checklist, Charts and Flight Forms.	

F. SIDE PANEL - LEFT

1.	Nose steering switch	Normal
2.	Windshield wiper selector switch	OFF
3.	Oxygen valve	Open
4.	Annunciator panel	Checked
5.	Oxygen regulator	Checked
6.	VHF control box	Checked & set
7.	Radar scope	Set
8.	Air ground switch	Ground
9.	Wing spoiler light	Checked
10.	Control surfaces position indicator	Checked

CHECK LIST USE

When the aircraft is stationary the First Officer will read the check list. The Flight Engineer will read check lists while the aircraft is moving.

Check list and procedures will be initiated only after the appropriate command has been given.

Check List - The items are the challenge-response type and are to be read aloud by the crewmember indicated above. The check and response will be accomplished by the crewmember at the right of each list.

After completing all items of a check the crewmember reading will announce "(appropriate) check complete". Example: "Before Start Check Complete". The following normal check list will be used for all normal flight condition.

Before Start Check:

This check list is read by the First Officer.

CHECK LIST USE (Cont'd)

Before Taxi Check:

This check list must be complete prior to brake release.

Taxi Check:

This check will be called for only after clear of the ramp, and is accomplished during taxi.

Before Takeoff Check;

This check should be called for and accomplished at Captain's discretion and must be completed prior to take off.

Climb Check:

These procedures are called for and accomplished after the aircraft is cleaned up, climb power set, and well clear of the airport traffic area.

Descent Check:

This check should be called for and accomplished while descending.

In Range

This check will be called for and accomplished as soon as possible prior to maneuvering for the approach.

Before Landing Check:

This check will be called for and accomplished during the approach for landing.

After Landing Check:

This check will be called for and accomplished after the aircraft is clear of the runway.

CL-44 OPERATING CHECK LIST

CODE - C = Captain
FE = Flight Engineer
GM = Ground Man
FO = First Officer
NFP = Non Flying Pilot
* = Flight Engineer Only

BEFORE STARTING

FLIGHT DOCUMENTS AND PASSPORTS	CHECKED	C
VOICE RECORDER	ON & CHKD	FO
GROUND POWER	AC & DC CHKD	FE
CIRCUIT	SET	FE
OXYGEN & SMOKE MASK	ON 100% & CHKD	C/FO/FE
SPOILERS	ON & CHKD	C
ANTISKID	ON	C
SEAT BELT & NO SMOKING	ON	C
IDLE THROTTLES	LOW	C
OIL COOLERS	AUTO OR OPEN (ABOVE 15° OAT)	C
GEAR LEVER	DOWN & CHKD	C
PARKING BRAKES	ON	C
POWER LEVERS	LOCKED GRD IDLE	C
CONDITION LEVERS	FUEL OFF	C
ARTIFICIAL FEEL	IN LIGHT OUT	C
VNO,ZFW, AURAL OVERSPEED	SET & TESTED	C/FO
CLOCKS, TEMP., ALTIMETERS	SET & CHKD	C/FP/FE
STATIC SELECTOR	NORMAL	FO
ANTI COLLISION & NAV. LIGHTS	ON	C
GROUND MAN READY	READY TO START	C
PNEUMATICS	NO. 1 PUMP ON W/L OUT	FE
HYDRAULICS	LOADED, PRESS. CHKD	FE
FUEL LOAD	LBS	FE
FUEL SELECTORS (1,2,3,4 TANK/ENG.)	SET	FE
MANIFOLD VALVES	ALL SEVEN CLOSED	FE
BOOSTER PUMPS (1,2,3,4 ON W/L OUT 5,6,7 OFF)	CHECKED & SET	FE
SUPERCHARGERS	SPILL	FE
STANDBY INVERTER	AS REQUIRED	FE
GEAR PINS	CHKD ON BOARD	C/FE
SEAT HARNESS	SECURED	C/FP/FE
CHECK LIST COMPLETE	COMPLETE	FO

BEFORE TAXI

NOSE STEERING	NORMAL (OFF PUSH BACK)	C
IDLE THROTTLES	FOUR HIGH	C
ENGINE INSTRUMENTS	NORMAL	C
RADAR	ON STANDBY	C
TRANSPONDER	ON STANDBY	C
FLIGHT RECORDER	ON LIGHT OUT	C
START SELECTOR	ALL	C
WINDSHIELD & PITOT HEATERS	LOW & ON	C

CL-44 OPERATING CHECK LIST

STANDBY INVERTER	NORMAL	FE
ANNUNCIATOR PANELS	CHKD LEFT & RIGHT	C/FO
DOORS AND WINDOWS	CLOSED LEFT/CLOSED RIGHT	C/FO
	LIGHTS OUT/HATCH CLOSED	FE
BACKING PUMP CHECK	BOOSTER PUMPS OFF	FE
GROUND UNITS & STEPS	REMOVED	C
TAXI SIGNAL & CLEARANCE	ALL CLEAR	C
FLAPS	AS REQUIRED	FO

CHECK LIST COMPLETE

TAXI

BRAKES	CHKD	C
TURN INDICATORS & COMP	CHKD LEFT & RIGHT	C/FO
INSTRUMENTS & RADIOS	SET LEFT & RIGHT	C/FO
AUTO PILOT	DISENGAGED & OFF	C
TRIM TABS 1,2,3	SET	C
FLAPS	CHECKED & SET 15°	FO
*ELECTRICAL AND ANTI-ICING	COMPLETE	FE
*IPM SWITCH	OFF	FE
*FUEL PANEL	BOOST PUMPS ON/SET	FE
*CONDITION LEVERS	TRIM SET	FE
TAKE-OFF TORQUE	OUTBOARD-INBOARD	FE

CHECK LIST COMPLETE

BEFORE TAKE-OFF

CONTROLS	UNLOCKED, LIGHT OUT	C/FO
GUST LOCK BY PASS SWITCH	AIR	C
TAKE-OFF SPEEDS	V_1,V_R,V_2, VFR	FO
BRIEFING	AS REQUIRED	C
ENGINE INSTRUMENTS	NORMAL	FE
CONTROL INDICATORS	5 FREE	C
ANNUNCIATOR PANEL	CLEAR LEFT & RIGHT	FE
TRANSPONDER AND RADAR	ON/CODE AS REQUIRED	FO
OMEGAS	SET	C
COMPASSES	CHKD LEFT & RIGHT	C/FO
BETA LIGHTS	OUT	FE
FINE PITCH	CHKD MIN TORQUE 35 PSI	FE
SUPERCHARGERS	SPILL	FE

CLIMB

GEAR	UP AND CHKD	C
FLAPS	AS REQUIRED (ABOVE 400 FT)	NFP
AIR GROUND LEVER	AIR	NFP
LANDING LIGHTS	UP & OFF (BELOW 165 KTS)	NFP

CL-44 OPERATING CHECK LIST

*VARIABLE AC	ON	FE
*HYDRAULICS	UNLOAD	FE
*PNEUMATICS	AUTO	FE
*ENGINE INSTRUMENTS	NORMAL	FE
*SUPERCHARGER	NORMAL	FE
*PRESSURIZATION	SET	FE
*ICE READY LIGHT	ON	FE
SEAT BELT & NO SMOKING	OFF/AS REQUIRED	FO
ANTI-SKID	OFF	NFP
ALTIMETERS	AS REQUIRED	C/FO
OIL COOLERS	AS REQUIRED	FE

CHECK LIST COMPLETE

CRUISE

CRUISE POWER	SET	C
ALTIMETERS	AS REQUIRED	C/FO
FLAPS	UP	C

CHECK LIST COMPLETE

DESCENT

NOSE STEERING	NORMAL	C
PARKING BRAKES	OFF	C
ALTIMETERS	SET	C/FO
WINDSHIELD HEAT	LOW	C
SEAT BELT / NO SMOKING	AS REQUIRED	FO
ANTI-SKID	ON	C
SPEEDS	V_{OF},V_2 FOR LBS	C/FO
CREW BRIEFING	NORMAL/AS REQUIRED	C
SEAT HARNESS	SECURED	C/FO
OIL COOLERS	AS REQUIRED	FE

CHECK LIST COMPLETE

IN RANGE

FUEL SELECTORS 1,2,3,4 TANK/ENG	SET	FE
BOOSTER PUMPS 1,2,3,4 ON	CHECKED & SET	FE
HSI, RADIOS	SET FOR LDG	C/FO
CREW BRIEFING	REVIEWED	C
FLAPS	15°	C
ALTIMETERS	SET & CROSS CHKD	C/FO
HYDRAULICS LOADED	PRESSURE CHKD	FE

CHECK LIST COMPLETE

CL-44 OPERATING CHECK LIST

BEFORE LANDING

AUTO PILOT	DISENGAGED & OFF/AS REQUIRED	C
GEAR	DOWN & CHKD	C
FLAPS	SET/AS REQUIRED	C
LANDING LIGHTS	AS REQUIRED	C
ANNUNCIATOR PANELS	CLEAR LEFT & RIGHT	FE
*BRAKE PRESSURE	CHECKED	FE
*CONDITION LEVERS	SET WHEN BELOW 2000 FT	FE
*VARIABLE AC	OFF	FE
*SUPERCHARGER	SPILL	FE

CHECK LIST COMPLETE

AFTER LANDING

FLAPS	UP	FO
GUST LOCK BY PASS SWITCH	GROUND	C/FO
CONTROLS	LOCKED	FO
TRANSPONDER	OFF	FO
RADAR	OFF	FO
PITOT HEAT	OFF	FO
WINDSHIELD HEAT	OFF	FO
FLIGHT RECORDER	OFF	FO
ARTIFICIAL FEEL	OFF	FO
HYDRAULIC PRESSURE	CHECKED	FE
IPM SWITCH	OFF	FE
BACKING PUMP CHECK	BOOSTER PUMPS OFF	FE
FIRE WARNING TEST	CHECKED	FE

CHECK LIST COMPLETE

PARKING

PARKING BRAKES	AS REQUIRED	C
LANDING LIGHTS	RETRACTED & OFF	C
SPOILERS	OFF	C
ANTI-SKID	OFF	C
NAVIGATION LIGHTS	AS REQUIRED	C
COLLISION LIGHTS	OFF/AS REQUIRED	C
START SELECTOR	OFF	C
INSTRUMENT LIGHTS	OFF	C
OXYGEN VALVE	OFF	C/FE
VOICE RECORDER	OFF	FE
PNEUMATICS	OFF	FE
BOOSTER PUMPS	OFF	FE
FUEL SELECTORS	OFF	FE
BATTERY SWITCH	AS REQUIRED	FE
G.P.U SWITCH	AS REQUIRED	FE
M.D.P. CIRCUIT BRKS	PULL	FE
RADAR COVERS	ON	C/FO

CHECK LIST COMPLETE

NORMAL OPERATING PROCEDURES EXPANDED CHECK LIST

Before starting engines

Before starting engines, the pilot must ensure that the following procedures have been carried out.

1. Portable fire extinguisher standing by.
2. A ground crew man standing in a position to assist during the starting operation.
3. The prestart engine check list has been completed.

Starting procedure

CL-44 aircraft use a low pressure (40 lbs. maximum) air start unit.

NOTE: On aircraft fitted with the "Soft start modification" there is a green "ready" light adjacent to the engine selector switch. This light must be ON before starting any engine.

Starting engines (Standard procedure)

The starting order for the engines is 1, 2 , 3 and 4.

The Flight Engineer will be responsible for the initial portion of the starting procedure - moving the condition levers to the "START" position and noting TGT and oil pressure.

NOTE: Keep hand on condition lever until TGT stabilizes - fuel off if TGT tends to exceed start limit.

The Captain will be responsible for moving the condition levers to RUN position, noting TGT and oil pressure.

The Captain will advise ground crew when ready to start and upon receipt of clearance, proceed as follows:

Responsibility	Item	Action
FE		Ready on No. 1
GM		No. 1 engine clear
FE	Engine start selector switch	No. 1 engine
FE	Engine start switch	Start
GM		Air on

CAUTION

The air supply for starting the engine must be controlled at 10 psig until START is selected. The pressure may then be uniformly increased to a minimum of 33 psig over a period of not less than four seconds. (Note: This function performed automatically when soft start modification is fitted.)

Responsibility	Item	Action
FE	When engine speed reaches 17% H.P.R.P.M.	Condition lever to START position

NOTE: Above I.S.A. obtain maximum H.P.R.P.M. posssible within starter limitations. It is recommended, however, that at least 18% H.P.R.P.M. be obtained.

Responsibility	Item	Action
FE	T.G.T. indication	Observe rise in T.G.T. If no increase in 20 seconds, carry out failure to start procedure.
FE	Oil pressure	Check for indication of 10 psi minimum.
FE	Engine start switch	Check OFF at 35% H.P.R.P.M. Approx.

CAUTION

Occasionally an engine may experience a "hung start" condition. This condition can be recognized by a failure of the H.P.R.P.M. to increase after starter cut-out and a slowly increasing T.G.T. Should this condition occur, the engine should be shut down and a second starting attempt made. Should the engine fail to achieve a successful start on the second attempt, a modified form of the "cold start" procedure should be employed.

NOTE: The start switch is held automatically in the START position up to 31 to 35% H.P.R.P.M. If, on reaching 35% H.P.R.P.M. the switch has not moved to the OFF position, it must be moved manually to that position within 10 seconds. On subsequent starts the start switch must be manually put off at 31 to 33% H.P.R.P.M.

Responsibility	Item	Action
FO	As START switch trips Off	Soft start light "On"

NOTE: L.P.R.P.M. should stabilize at 16% to 24% T.G.T. will peak and then stabilize at a lower temperature.

Responsibility	Item	Action
Capt.	Condition lever	Weak when engine speed stabilizes

CAUTION

After placing the condition lever to Trim Weak or Run, a rapid rise in T.G.T. can be expected. Control of T.G.T. can be accomplished by lifting the condition lever until T.G.T. decreases. In no case must the T.G.T. be allowed to exceed a mementary 725° C. If control of T.G.T. is impossible, move the condition lever to FUEL OFF.

Responsibility	Item	Action
Capt.	Idle throttle valve indicator	Check high
Capt.	Condition lever	Set trim
Capt.	Oil pressure	Normal

Failure to start

(No increase in T.G.T. or no increase in H.P.R.P.M. above motoring speed of 16% to 23% within 20 seconds)

Condition lever	Fuel off
Engine start switch	Off

If there has been any delay in moving the condition lever to fuel off, carry out a ground cranking cycle. This must be done in any case after two unsuccessful starts. Check for proper fuel drainage after failure to start has been experienced.

Ground cranking

Condition lever	Fuel off
Engine start switch	Crank (hold to crank for 40 seconds)

CAUTION

Do not initiate a second start or a ground crank cycle until the engine has come to rest as indicated by the H.P.R.P.M. indicator. Starter engagement with the engine rotating will damage the starter.

Cold start

(At low ambient temperatures it may be necessary to increase the starting fuel flow to obtain a successful start. Proceed as follows.)

Condition lever	Fuel off
Idle throttle C/B	Out
Condition lever	Start position
Idle throttle C/B	In (for 3 to 5 seconds, then out.)
Condition lever	Fuel off

Carry out normal start.

(When the above procedure is used to correct for a "hung start" condition the timing for C/B (3 to 5 seconds) should be decreased.)

When condition lever is placed to the run position after a successful start, the idle throttle C/B should be pushed in to complete the start cycle.

NORMAL OPERATING PROCEDURES

Flap Check

The following flap system check will be accomplished on each main base departure.

1. Prior to taxi and after obtaining ground crew clearance, select flaps to 45°. Time for the flaps to reach the 45° position should take approximately 25-27 seconds.

   NOTE: With one flap inoperative, the flap operation speed will be doubled.

2. While taxiing, select flaps to 15° with the flap selector switch. When the flaps reach approximately 25°, place the flap emergency switch to the emergency position and note that the flap travel stops. Inch the flaps down to 30° and up to 25° with the flap alternate extension switch. Return emergency flap switch to normal position allowing the flaps to continue to the 15° position.

3. The Flight Engineer should check the momentary load on the number 1 & 4 constant-frequency loadmeters while the flaps are run up & down with the alternate switch to check the operation of the flap motors. CHECK LOAD NORMAL.

NORMAL FLIGHT HANDLING PROCEDURES

To achieve complete co-ordination on the flight deck, check lists and standard cockpit commands and terminology will be used. To prevent any possible confusion, first name the item to be checked, second the desired value, e.g. "Flaps 15"; "Gear up". In order to avoid any possibility of error or misunderstanding, all commands given on the flight deck must be repeated back in the acknowledgement and again confirmed when the action required has been completed, e.g. CAPTAIN . . . "Flaps 15°". FIRST OFFICER . . . "Flaps 15°. Flaps 15°, SET AND INDICATED". Checks will always be carried out using the appropriate check list taken from the aircraft library.

The captain should call for the appropriate check list when required, and he should not assume that it will be read automatically. The first officer is responsible for ensuring that a given command is correctly acknowledged. The reading of a check list should never be continued past an omitted item.

Where the engineer officer has a separate check list, the first officer will request confirmation that the engineer officers section is complete before reporting "Check completed" to the captain.

For an originating flight all items on the external and internal check lists will be checked, but for a transit, only those items marked by an asterisk need be covered, unless there is reason to doubt the serviceability of such items.

The normal operating check lists use abbreviations to indicate the crew member who is required to carry out the appropriate actions:

C = Captain
F/O = First Officer
F/E = Flight Engineer
NFP = Non Flying Pilot
G/M = Ground Man
* = Flight Engineer Only

The pilot reading the check list must ensure that he does not merely read out the items, he must ensure that they are done. It is emphasized that no emergency or check list procedure may be commenced unless the captain or his nominee initiates it. This particularly applies to the emergency check list.

The boxed items on the emergency check list must be committed to memory and pilots should be familiar with the actions appropriate to both pilots' seats, including the situation where the engineer officer is absent from the flight deck. All other sections of the emergency drills should be carried out by reference to the check lists and not from memory.

STANDARD PROCEDURE FOR THE PROPER USE AND SETTING OF ALTIMETERS

	Port	Starboard
1. Before starting check:		
Set and cross-checked Check for serviceability	QNH	QNH
2. After take-off check:		
Set and cross-checked	QNH	QNH
3. Passing transition altitude: climbing:		
Set and cross-checked	29.92" QNH when terrain clearance check required.	29.92"
4. During descent when cleared down to an altitude:		
Set and cross-checked	QNH	QNH
5. During initial approach:		
Set and cross-checked	QNH	QNH
6. During final approach:	QNH	QNH
7. During overshoot procedure:	QNH	QNH

During enroute flying in areas where QNH is used to obtain vertical separation, the QNH should be selected on both instruments.

PRE-FLIGHT, STARTING AND TAXIING

Pre-Flight

The commander must satisfy himself that all sections of the certificate file are in order for the intended flight. It is his responsibility to ensure that the load is secure and in accordance with the loadsheet. However, he may delegate this responsibility to a member of his crew or to the station staff responsible for loading.

Before commencing to taxi, the Commander must ensure that the operating pilots are wearing their harness and that both lap strap and shoulder harness are fitted correctly. As pilots have difficulty in reaching some controls with the harness locked, it is not necessary to have the side lever in the locked position. In the unlocked position any sudden fast movement should cause the shoulder harness to lock, this can be released by putting the side control lever to the locked and then back to the unlocked position.

If parked in a confined space, arrange for ground personnel to be positioned as necessary to guide the aircraft clear of all obstructions. The pre-flight check will be carried out in the approved manner as set out in the external and internal check lists.

Starting

Worthwhile savings in fuel consumption can be made by eliminating waiting time at the end of the runway while other traffic is running up or standing by for clearance. At those airports where it is possible to request "start up" clearance, this must be done and ATC will then begin to progress clearance.

Before starting the engines it is desirable to check the position of the aircraft in relation to adjacent buildings, aircraft and equipment. The before-starting check should be completed as far as possible by the first officer prior to the captain's arrival on the flight deck. This will help minimize any delay if the captain is detained for any reason. The Captain should ensure that any special instructions, such as briefing for take-off, are given to the crew before start-up.

During all ground running with aircraft stationary, power levers should be in GROUND RUN position to avoid overheating of engines, auxiliary gear box oil and electrical components. Engine oil temperatures should be monitored during ground running and if they reach 80° C. power levers should be placed to the MAX BETA position until oil temperatures drop.

Taxiing

Obtain hand or flashlight signal from ground before releasing brakes, indicating all clear below. Apply power smoothly and evenly to start the aircraft rolling, and when desired speed is attained, bring the power levers back to a position to maintain the required taxiing speed.

If power levers are in GROUND IDLE during taxiing, the propeller blade tips are in slight reverse pitch angle but the balance of the blade is in forward thrust. This results in the tips picking abrasive material off the taxiways while the rest of the propeller sucks such material into the engine. Abrasive material ingestion accompanied by subsequent blade erosion in the compressor and turbine sections of the engine can be kept to a minimum by taxiing with the power levers in GROUND RUN. In this position the entire propeller blades assumes a positive thrust angle. Therefore, whenever practicable, taxiing should be accomplished in GROUND RUN, using brakes to control taxi speed. It may be necessary to alternate between GROUND RUN and GROUND IDLE in order to prevent taxi speed building up, with consequent excessive use of brakes.

Once the aircraft is moving, manipulating of the power levers in the beta range will normally cover all thrust requirements for taxiing. The power levers must not be moved away from the GROUND IDLE position until the LP speed has reached at least 52.3% R.P.M.

Ensure that brake pressure is checked and system on load before moving and during prolonger taxiing. Check brakes smoothly as early as possible. At night, the continuous use of taxiing lights is advocated. Both pilots' seats must be occupied at all times during taxiing to check wing tip and propeller clearances. An adequate lookout must be maintained by both pilots, and completion of the taxiing must be subordinated to this requirement.

Continuous use of the brakes will gradually generate excessive heat which cannot be dissipated while taxiing, resulting in brake plate distortion and eventual failure. At all times avoid "riding" the brakes.

Nose wheel steering is used to maintain directional control. Avoid tight turns and harsh use of the nose steering control, both in starting and stopping a turn. When a tight turn is necessary, speed must be reduced to 3-5 MPH.

Do not attempt to overcome the 50° steering limit by use of engines and/or brakes, as damage to the landing gear may result. Should difficulty be experienced with nose wheel steering, selection of nose wheel steering switch to OFF permits castoring of the nose wheel within its limits and turns can be made by use of differential braking.

A runway width of at least 150 ft. is required for a 180° turn, this with the outboard propeller overhanging the area adjacent to the runway edge. A runway width of 200 ft. is necessary for complete undercarriage and propeller clearance on the paved surface.

For 180° turns on an average 150 ft. width runway, position aircraft at extreme edge of runway taxiing on a straight path for at least 10 yards before commencing the turn. In the event of not being able to complete the turn on the runway, the aircraft should be stopped with a view to "backing up". In this case, centralize the nose wheel before stopping.

DO NOT USE THE WHEEL BRAKES TO STOP WHILE TAXIING REARWARD, as wheel braking might tip the aircraft onto its tail. The pilot must bear in mind that greater thrust is available in reverse than in forward BETA range and therefore rearward movement of the aircraft must be initiated SLOWLY.

Reverse taxiing must be used with caution. If it becomes necessary however, the captain must first satisfy himself that there are no obstructions behind the aircraft. Taxiing backwards should be carried out very slowly by selecting power levers into reverse on all four engines as required. Forward thrust must be used to stop rearward movement of the aircraft, as use of brakes might cause the tail to hit the ground.

Brakes should not be used during turns, but in the event of them having to be used to further reduce speed, they must be used symmetrically. On no account will differential brake be used during turns with the nose wheel switch to NORMAL. It should be borne in mind that when taxiing over icy or snowy sections, it may be necessary to use a certain amount of brake and/or power if nose wheel becomes ineffective due to skidding.

Propeller clearances are limiting on this aircraft (outers 20 1/2", inners 14 3/4"); therefore, extreme caution must be exercised at all times when taxiing, expecially when close to runway lights and other obstacles at the edge of taxiways. These obstacles could be a hazard if above 12". This figure allows for such items as camber, oleo depression, etc. There is also a danger of loose stones, gravel, etc., being drawn up when outboard propellers are over rough ground.

The distance between the outboard propeller spinners is 63 ft. 4", and the propeller radii are 16 ft. makine a total overall width of 79 ft. 4", from the edge of propeller clip to edge of propeller clip. However, note that although the clearance from the ground vertically under the outboard propeller spinner is 20½", som 4 ft. further out the ground clearance is 32" and a total of 6 ft.; further out, the ground clearance is 50". These figures should be borne in mind when negotiating snow banks, etc.

When negotiating corners, special care must be taken to avoid wheels cutting the corner, and to obviate the danger of the outboard propeller hitting obstacles.

On a wet greasy runway, if a turn is made too sharply, it is possible to make the nose wheel skid. This will be apparent by a rough rumbling noise, and the immediate action must be to reduce the amount of steering angle and to slow down. The tendency of the nosewheel to skid will be accentuated by an aft C. of G. and by a crosswind. On slippery surfaces, differential power and brakes may give more effective control than nosewheel steering.

When entering a marshalling area ensure that power levers are slightly forward of the GROUND IDLE position to avoid blowing dust, stones, snow, etc., over ground personnel.

The aircraft must always be parked with the nosewheel straight.

CREW BRIEFING SPEEDS

Pilot will brief the crew on procedures and duties during the take-off including speeds, possible rejected take-off.

a. When the Captain is flying the aircraft from the left hand seat, THE FIRST OFFICER WILL BE INSTRUCTED TO:

1. Hold the control column forward until V_1, decreasing forward pressure as airspeed increases.

2. Call out 80 knots, V_1, V_R, V_2, V_{FR}.

3. Follow up on power levers.

4. In case of reject, ensure that the Air/Ground lever in Ground and hold the control column forward.

5. Captain will bring power levers to ground range, the Flight Engineer will call out Beta Lights, then the power levers will be retarded symmetrically towards full reverse to provide maximum deceleration assistance to the brakes.

b. When the First Officer is flying the aircraft from the right hand seat, the briefing will cover the following points:

1. The First Officer will advance the power levers to full power and hold the control column forward.

2. The Captain will maintain directional Control initially by nosewheel steering, and standby on the steering wheel until V_1.

3. The Captain will call out 80 knots, V_1, V_R, V_2, V_{FR}.

4. In the case of a failure before V_1, at the Captain's command reject, the First Officer will retard the power levers to Flight Idle, and then check the Air/Ground Lever in Ground position, and hold the control column fully forward. The Captain will select reverse power and bring the aircraft to a stop.

c. Whichever pilot if flying the aircraft, the briefing for the Flight Engineer remains the same. THE FLIGHT ENGINEER WILL BE INSTRUCTED TO:

1. Call out power up at 80 knots.

2. Monitor the engine instruments.

3. Call out any failure.

4. Monitor Beta lights.

NOTE: The Captain will order any emergency action required and the Flight Engineer will carry it out on his command.

d. If any unusual circumstances exist which would require deviation from normal procedures: i.e. Altitude restrictions, obstacles, complex instrument departure, weather, etc., the First Officer and Flight Engineer should be briefed accordingly.

e. The purpose of the Pre-Take-Off Briefing is to impress upon ALL crew members concerned, what is expected of them during a normal take-off. At the Captain's discretion, based on his PERSONAL knowledge of the experience level of the crew members concerned, he may abbreviate the briefing to include only, "Standard Briefing, the V_1 is ...., the V_R is ...., departure is climb to 2000 feet, right or left turn on course, etc.

MINIMUM TAKE-OFF TORQUE - INBOARD & OUTBOARD

Compute minimum torque from take-off power chart. (Ref. Figure 2)

FUEL TRIM PROCEDURES

Take-Off at 99.8% L.P.R.P.M. (Ref. Figure 3)

This chart is to be used to set the Condition Levers (Trim Levers) prior to take-off according to the airfield pressure altitude and static (tower) temperature, e.g., 2,000' and 20°C, require a trim position of 42 and the overriding T.G.T. limit is 670°C. This chart must be used to obtain the aircraft performance given in the Airplane Flight Manual.

Maximum Continuous at 94.9% L.P.R.P.M. (Ref. Figure 4)

This chart is to be used for all operation at this power. The chart should be entered with the prevailing pressure and the indicated air temperature as given by the OAT bulb. This chart must be used to obtain the aircraft performance given in the Airplane Flight Manual.

Normal All-Engine Climb by 88.3% L.P.R.P.M. (Ref. Figure 5)

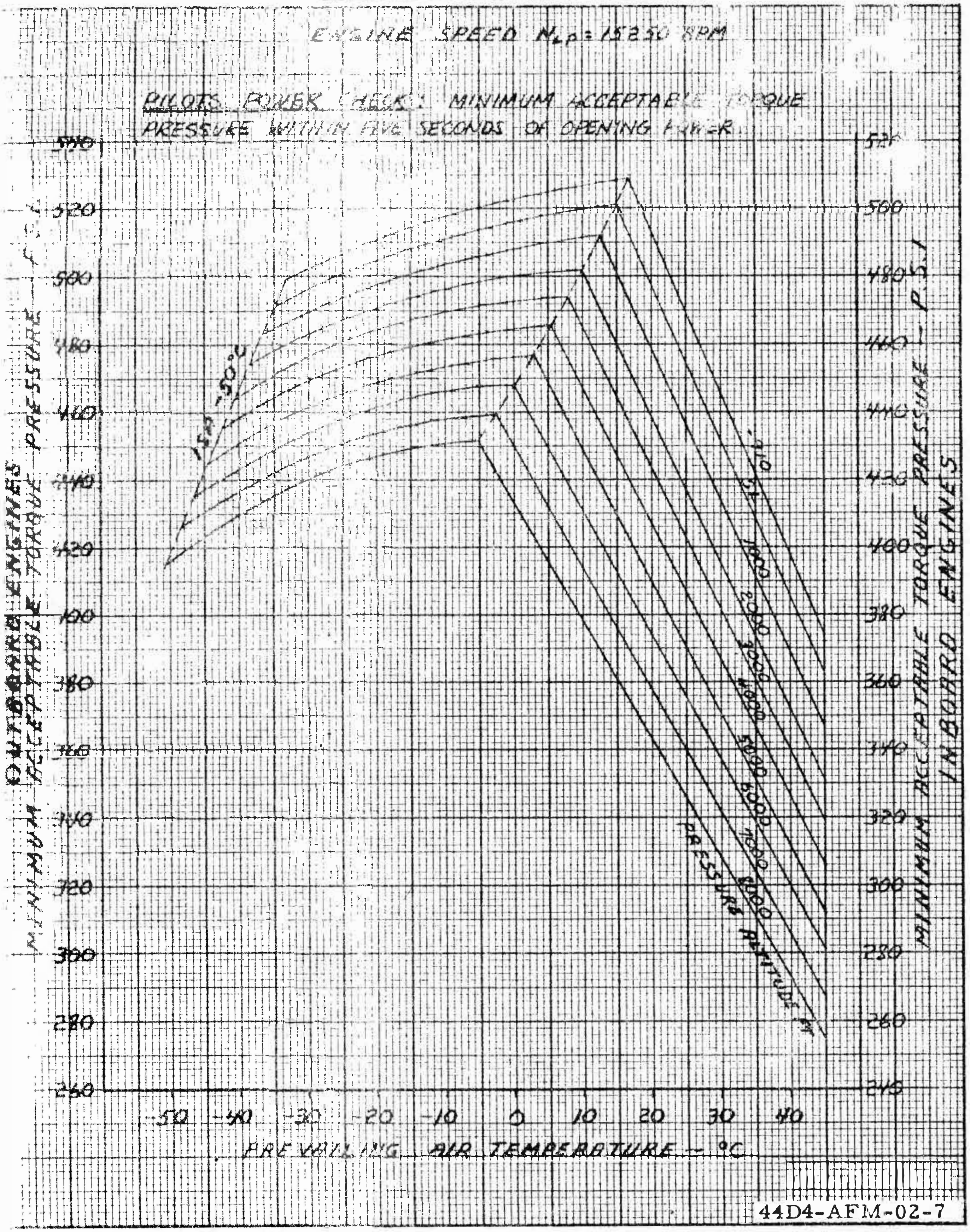
The charts on Figure 5 give the fuel flow (per engine) for various altitudes, climb airspeeds and indicated outside air temperatures. An overriding T.G.T. limitation is shown in the column next to the altitude. The T.G.T. limitation for climb is now identical to the T.G.T. limitation for cruise at the same altitude.

Climb will be executed at one of the specified climb speeds, depending on take-off gross weight.

Charts are provided for operation "without hot air anti-icing" and "hot air anti-icing".

TAKE-OFF

On completion of the before take-off check, apply power smoothly until power levers are fully advanced and call "Full power set". The pilot should have his left hand lightly on the nose wheel steering wheel and his right hand on the power levers so as to maintain control of the aircraft up to V_1 speed. Nosewheel steering is to be used for directional control until the rudder becomes effective.



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Take-off Power Check
Figure 2

TYNE MK 515 - TAKE-OFF AT 99.8% (15250) L.P. R.P.M. AND 1243°K.

Alt. Feet	MOD. 1426 Max.TGT deg.C.		CONDITION LEVER POSITION																																							PRE-MOD. 1426 Max.TGT deg.C.
			R	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	
-2000	665		23	24	25	26	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		51	52	53	54									735
-1000	665		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52						735
SL	665		15	16	17	18	20	21	22	23	24	25	26	27	28	29	30	31	32		33	34	35	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51					735
1000	667		13	14	15	16	17	19	20	21	22	23	24	25	26	27	28	29	30	31		32	33	34	35	36	37	39	40	41	42	43	44	45	46	47	48	49					737
2000	670		11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29	30		31	32	33	34	35	36	38	39	40	41	42	43	44	45	46						740
3000	672	FOR AIR TEMPERATURES	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28		29	30	31	32	33	34	35	36	37	39	40	41	42	43	44						742
4000	675	COLDER THAN THOSE	6	8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25	26		27	28	29	30	31	32	33	34	35	36	37	39	40	41	42	43					745
5000	677	SHOWN AT A GIVEN ALTITUDE USE TRIM	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	41					747
6000	680	FULL RICH	1	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39					750
7000	682		1	0	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36					752
8000	685		3	2	1	0	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	24	25	26	27	28	29	30	31	32	33	34	35					755
9000	687		5	4	3	2	1	0	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33				757
10000	690		8	7	5	4	3	2	1	0	1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31				760
11000	692		10	9	8	7	6	5	3	2	1	0	1	2	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	27	28	29				762
12000	695		14	12	11	10	9	7	6	5	4	3	2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22	23	24	25	26				765
13000	697		17	16	14	13	11	10	9	7	6	5	4	3	2	1	0	1	2	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25			767
14000	700		20	19	17	16	14	13	11	10	9	8	7	6	5	4	3	1	0	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	22	23			770
15000	702		23	22	21	19	18	16	15	13	12	11	10	8	7	6	5	4	3	2	1	0	1	2	3	5	6	7	8	9	10	11	12	13	14	16	17	18	19	20			772

Indicated Air temperature - °C.

NOTE: Indicated air temperatures below the stepped line are below 0 degrees C.

20454

Fuel Trim Chart - Take-Off and Climb
at 99.8% L.P.R.P.M.
Figure 3

TYNE Mk.515 - MAXIMUM CONTINUOUS AT 94.9% (14500) L.P. R.P.M. AND 1221 deg.K.

Alt. Feet	MOD. 1426 Max.TGT. deg.C.	CONDITION LEVER POSITION - WITHOUT HOT AIR ANTI-ICING																																														PRE-MOD. 1426 Max.TGT. deg.C.
									R	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	
-2000	645	23	24	25	26	27	28	29	30	31	32	33	34	35		36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	57	58	59											715
-1000	645	17	18	20	21	22	23	24	25	26	27	28	29	30		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	53	54	55	56									715
SL	645	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	49	50	51	53	54	55						715
1000	647	8	9	10	11	12	13	14	15	16	17	18	19	20	22		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	47	49	50	51	52	53				717
2000	650	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		28	29	30	31	32	33	34	35	36	37	38	40	41	42	43	44	46	47	48	49	51	52				720
3000	652	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	48	49	50				722
4000	655	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	41	42	43	44	46	47	48				725
5000	657	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	41	42	44	45	46				727
6000	660	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	40	42	43	44				730
7000	662	2	1	0		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	38	40	41	42				732
8000	665	4	3	2	1	0		1	2	3	4	5	6	7	8	9	10	11	12	13	14		15	16	17	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	38	39	40	41			735
9000	667	6	5	4	3	2	1		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	28	29	31	32	33	34	35	37	38	39				737
10000	670	8	7	6	5	4	3	2		1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	29	30	31	32	33	35	36	37				740
11000	672	11	9	8	7	6	5	4	3		2	1	0	1	2	3	4	5	6	7		8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25	27	28	29	30	31	33	34	35			742
12000	675	13	12	11	9	8	7	6	5	4	3		2	1	0	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	23	25	26	27	28	30	31	32	33			745
13000	677	16	14	13	12	11	9	8	7	6	5	4		3	2	1	0	1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	24	25	26	27	29	30	31			747
14000	680	18	17	16	14	13	12	11	10	8	7		6	5	4	3	2	1	0	1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	22	23	24	25	26	28	29	30		750
15000	682	21	20	18	17	16	15	14	12	11	10	9	8	7	6	5	4	3	2		1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	22	23	24	25	26	27	28	752
16000	685	23	22	21	20	19	17	16	15	14	13	11	10	9	8	7	6	5		4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	17	18	19	21	22	23	24	25	26	755
17000	687	26	25	24	22	21	20	19	18	16	15	14	13	12	11	9	8		7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	18	20	21	22	23	24	757
18000	690	29	28	26	25	24	23	21	20	19	18	17	16	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		1	2	3	4	5	6	7	9	10	11	12	14	15	16	17	18	19	21		760
19000	692	32	31	29	28	26	25	24	23	22	20	19	18	17	16	15	14	12	11	10	9	8	7	6	5	4	3	2		1	0	1	2	3	4	5	7	8	9	10	11	13	14	15	16	17	18	19	762
20000	695	35	34	32	31	29	28	27	25	24	23	22	21	20	19	17	16	15	14	13	12	10	9	8	7	6	5	4		3	2	1	0	1	2	3	4	6	7	8	9	10	12	13	14	15	16	17	765
21000	697	38	36	35	33	32	31	30	28	27	26	24	23	22	21	20	19	18	17	15	14	13	12	11	10	8	7	6		5	4	3	2	1	0	1	2	4	5	6	7	8	10	11	12	13	14	15	767
22000	700	41	40	38	36	35	34	32	31	30	28	27	26	25	23	22	21	20	19	18	17	15	14	13	12	11	10	9	8	6		5	4	3	2	1	1	2	3	4	5	6	8	9	10	11	12	13	770
23000	702	44	42	41	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	17	16	14	13	12	11	10	9	7	6	5	4	3	2	1	0	1	2	3	4	6	7	8	9	10	11	772
24000	705	46	45	44	42	41	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	17	16	14	13	12	11	10	8	7	6	5	4	3	2	1	0	1	3	4	5	6	7	8	9	775
25000	707	50	48	46	45	43	42	41	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	17	16	14	13	12	11	9	8	7	6	5	4	3	2	0	1	2	3	4	5	6	7	777
26000	710	52	50	49	47	46	45	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	23	22	20	19	18	17	15	14	13	12	10	9	8	7	6	5	3	2	1	0	1	2	3	4	5	780
27000	712	55	53	51	50	49	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	16	15	14	13	11	10	9	8	6	5	4	3	2	1	0	1	2	3	782
28000	715	57	56	54	53	51	50	48	47	46	44	43	42	40	39	37	36	35	33	32	31	29	28	27	26	24	23	22	21	20	19	17	16	15	13	12	11	9	8	7	6	5	3	2	1	0	1		785
29000	717	60	58	57	55	54	52	51	49	48	47	45	44	43	41	40	39	37	36	34	33	32	30	29	28	27	25	24	23	22	21	19	18	17	16	14	13	11	10	9	7	6	5	4	3	2	1	0	787
30000	720	62	61	59	58	56	55	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	23	21	20	19	18	16	15	13	12	10	9	8	7	5		4	3	2	790

INDICATED AIR TEMPERATURE deg.C.

CONDITION LEVER POSITION - WITH HOT AIR ANTI-ICING

PRE-MOD. 1313,1314.....	R	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
MOD.1313,1314.........			R	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6

NOTE: Indicated air temperatures below the stepped line are below 0 deg.C.

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Fuel Trim Chart
Maximum Continuous Climb at 94.9% L.P.R.P.M.
Figure 4

TYNE MK.515 - CLIMB 88.3 (13500) L.P. R.P.M. AND 1164 deg.K.

Alt. Feet	MOD. 1426 Max.TGT. deg.C.	CONDITION LEVER POSITION - WITHOUT HOT AIR ANTI-ICING R 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10	PRE-MOD. 1426 Max.TGT. deg.C.
-2000	600	17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 56 57 58 59 60	660
-1000	600	12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 49 50 51 52 53 54 55 56 57	660
SL	600	7 8 9 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 42 43 44 45 46 47 49 50 51 52 53 54 55	660
1000	601	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 41 42 43 44 45 46 47 48 49 50 51	661
2000	603	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 39 40 41 42 44 45 46 47 48 49	663
3000	604	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 41 42 43 44 45 46 47	664
4000	606	2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 38 39 40 41 42 43 44 45 46	666
5000	607	4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 35 36 37 38 39 40 41 42 43 44	667
6000	609	6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 33 34 35 36 37 38 39 40 41 42	669
7000	610	8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 29 30 31 32 33 34 35 36 37 38 39 40	670
8000	612	10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 26 27 28 29 30 31 33 34 35 36 37 38	672
9000	613	12 11 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 31 32 33 34 35 36	673
10000	615	13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 28 29 30 31 32 33 34	675
11000	616	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 25 26 27 28 29 30 31 32	676
12000	618	17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30	678
13000	619	19 18 16 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 20 21 22 23 24 25 26 27 28 29	679
14000	621	21 20 19 18 16 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26 27	681
15000	622	23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 16 17 18 19 20 21 22 23 24	682
16000	624	25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 8 9 10 11 12 14 15 16 17 18 19 20 21 22	684
17000	625	28 27 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 7 8 9 10 11 13 14 15 16 17 18 19 20	685
18000	627	30 29 28 27 26 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17 18	687
19000	628	32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 2 3 4 5 6 7 8 9 11 12 13 14 15 16	688
20000	630	35 34 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 0 1 2 3 4 5 6 7 9 10 11 12 13 14	690
21000	631	37 36 35 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 7 8 9 10 11 12	691
22000	633	39 38 37 36 35 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 5 6 7 8 9 10	693
23000	634	41 40 39 38 37 36 35 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8	694
24000	636	44 42 41 40 39 38 37 36 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 2 1 0 1 2 3 4 5 6	696
25000	637	46 45 43 42 41 40 39 38 37 36 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 16 14 13 12 11 10 9 8 7 6 4 3 2 1 0 1 2 3 4	697
26000	639	48 47 46 44 43 42 41 40 39 38 37 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 7 6 5 4 3 2 1 0 1 2 3	699
27000	640	50 49 48 47 45 44 43 42 41 40 39 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 11 10 9 8 7 6 4 3 2 1 0 1	700
28000	642	52 51 50 49 47 46 45 44 43 42 41 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 8 7 6 5 4 3 2 1 0	702
29000	643	54 53 52 51 49 48 47 46 45 44 43 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 11 10 9 8 7 6 5 4 3 2	703
30000	645	56 55 54 53 51 50 49 48 47 46 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 16 15 14 13 12 11 9 8 7 6 5 4	705
		INDICATED AIR TEMPERATURE deg.C.	

CONDITION LEVER POSITION - WITH HOT AIR ANTI-ICING

PRE-MOD.
1313,1314 .... R 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

MOD.1313,1314 .... R 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3

NOTE: Indicated air temperatures below the stepped line are below 0 deg.C.

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Fuel Trim Chart - Climb at 88.3% L.P.R.P.M.
(13,500 L.P.R.P.M. - 1164°K TET)
Figure 5

During the take-off roll, the First Officer should maintain a light forward pressure on the control column until the pilot takes over control. This is to assure maximum nosewheel steering capability during the initial roll, and to prevent any excessive yaw in the event of an engine failure prior to rotation.

At V_1 knots, the Captain will take his hand off the nosewheel steering and place it on the control column. The Flight Engineer will call "power up." When the First Officer calls V_1, the Captain will say "I have control". At this point, he will put his hand on the control column and transfer the power lever control to the First Officer.

The First Officer will call "Rotate when V_R is reached", at which point the Captain will rotate the aircraft to the climb attitude in a smooth continuous rotation. When airborne, and a positive rate of climb is established, the Captain will raise the gear. Crosscheck climb attitude by reference to ASI, rate of climb and approach horizons.

NOTE: Do not apply the brakes to stop wheel rotation before gear retraction.

Power may then be reduced to climb power. The best gradient of climb with flaps 15° for the obstacle clearance case is obtained by climbing at V_2. Continue the climb, increasing speed to the minimum flap retraction speed V_{FR}, and at, or above, 400 ft., order the First Officer to retract the flaps. Allow the aircraft to accelerate while still climbing to the enroute climb speed and order the climb checklist to be completed.

NOTE: If, after take-off, the landing gear lever cannot be placed to the UP position, release the ground safety solenoid by operating the emergency button.

When the pilot opens the power levers fully, the Flight Engineer will ensure that minimum torque is achieved in 5 seconds, and will report "Power Up" at 80 knots. He will adjust condition levers as necessary, ensuring that engine limitations are not exceeded, and monitor the torque indicators and T.G.T. gauges during the take-off run, reporting immediately any abnormalities.

The First Officer will hold the control column forward of neutral until he reports "V_1", when the control column is taken over by the Captain. The First Officer will then take over the power levers, maintaining full power. He will report V_1, V_R, V_2, "Gear up" and the minimum flap retraction speed, and raise the flaps as ordered by the Captain. When the Captain orders "Climb power", the first officer will set up the required power. The Flight Engineer will monitor all engine readings and will action any malfunctioning of the electrical, fuel, de-icing and pressurization panels.

NOTES: 1. Speeds obtained from check lists are all IAS.

2. Stalling speeds are for zero thrust. Use of maximum continuous power will, therefore, reduce stall speeds by several knots.

3. The position of the landing gear does not significantly affect the stalling speeds.

4. Minimum flap retraction speed is 1.25 x stall speed.

5. Best climb speed is the enroute climb, and is 1.5 x stall speed for 4 engines, and 1.35 x stall speed for 3 and 2 engines.

NOISE ABATEMENT

The recommended procedure to obtain best climb where there is a noise problem is as follows: After lift off, climb ahead accelerating to 160 kts. with flaps at 15°. Maintain 160 kts, until 1500 ft., then increase to normal speed. Make power reductions in accordance with normal technique.

ENGINE FAILURE ON TAKE-OFF

Definitions

VMCG is the minimum speed at which the take-off can be continued using only the aerodynamic controls to maintain direction on the ground when an outboard engine suddenly becomes inoperative with the remaining three engines at take-off power. VMCG on the CL44 is approximately 95 kts.

V_1 is the maximum speed at which the pilot can recognize an engine failure during the take-off run and stop within the scheduled runway length.

V_R is the speed at which the pilot starts to rotate the aircraft to obtain the V_2 speed at 35 feet above the runway surface. V_R must not be less than V_1 or 1.05 VMCA.

VMCA is the minimum flight speed at which the aircraft is controllable with a maximum allowable bank angle of 5°, when an outboard engine suddenly becomes inoperative with the remaining three operating engines at take-off power. On the CL44, this is approximately 104 kts.

V_2 is the take-off safety speed required to permit attainment of the required take-off climb gradient, and shall not be less than:

1. 1.15 x zero thrust stall with wing flaps in the take-off position, and

2. 1.10 x the VMCA.

Engine Failure Before V_1

If an engine fails prior to reaching V_1, the take-off must be aborted. The pilot should retard the power levers and apply maximum braking simultaneously. Maximum use should be made of reverse thrust, the aircraft being controlled directionally by rudder, with nosewheel steering, or with differential braking if necessary. The First Officer, on seeing the closure of the power levers, or on receiving an order indicating the abandoning of the take-off, will push the control column fully forward amd check air ground lever "ground" and the Flight Engineer report when all engines are in ground range by calling "BETA lights on". As soon as possible after aborting take-off, carry out appropriate emergency drill on failed engine, and complete the after landing check.

Engine Failure After V_1

If an engine fails after V_1 has been attained, take-off should be continued. The pilot will keep the control column firmly forward maintaining the aircraft straight by use of rudder and aileron to maintain the lateral level. It is required during certification testing that the aircraft be controlled on the ground solely by aerodynamic means after V_1 with an outboard engine failed. However, as some lateral deviation is allowed, some nosewheel steering may also be required to maintain a straight path, particularly in strong crosswind conditions.

When the First Officer calls "Rotate" the pilot will rotate the aircraft decisively to climb attitude, retract the gear when a climb is established, and climb at V_2 as necessary to obtain obstacle clearance. Some aileron may be required to aid directional control when airborne.

Order the Flight Engineer to carry out the engine failure drill as required at a safe altitude. Increase speed to minimum flap retraction speed, and order First Officer to retract the flaps to zero, at a minimum of 400 ft. Continue climbing at this speed, until at a safe altitude, then increase speed to the 3 engine en route climb speed, and reduce 3 engine to climb power. The pilot should ensure that the after take-off and emergency check lists are completed.

NOTES: 1. The power lever of a failed engine must not be retarded until the condition lever has first been moved to FEATHER. Retarding the power lever at this stage will cause the propeller blades to move into a finer pitch.

2. With one engine out, when obstacle clearance is limiting to extract the maximum performance as published in the Flight Manual, the pilot should maintain V_2 to 1500 ft. The second segment climb which finishes at 1500 ft. is always attainable within the 5 minute engine time limit for use of full power.

TAKE-OFF IN CROSSWINDS

During a take-off with a strong crosswind component, especially on a wet runway, the aircraft should be kept straight by use of coarse rudder aileron as required to maintain the lateral level, and nosewheel steering until positive rudder control is attained.

It is important that the nosewheel should be kept firmly on the ground by holding the control column forward of central until rotate, as the nosewheel steering will lose some of its effectiveness, particularly on a wet runway, or with an aft C. of G.

The use of nosewheel steering should be kept to a minimum at higher speeds, as scuffling of the nosewheel tires may occur. At rotate, a firm break with the runway should be made.

The maximum crosswind component for take-off is 25 kts. Local conditions, e.g. state of runways, etc., would dictate the maximum crosswind which can be accepted for any particular take-off.

CLIMB

When take-off maneuvers have been accomplished and the climb check completed, the en route climb is commenced to selected cruise altitude. Altimeters should be crosschecked every 5,000 ft. on climb.

Two- and Three-Engine Climbs

Climbing speeds for two- or three-engine operation are tabulated in the Manual.

CRUISE

On reaching the selected cruising altitude, which will be found in the Cruise Control Tables in the Manual, the aircraft should be leveled off, power being maintained at climb settings. Check the spoiler lights are out above 200 kts. IAS. If not, select spoiler switch OFF.

When the speed has built up to the desired cruising speed, set up the required cruise regime. The maximum altitude for CL44 operations is limited to 30,000 ft.

To obtain the maximum aircraft performance it is important that the aircraft is correctly trimmed. When in cruising conditions, check rudder and aileron trims set to zero. Check on rudder position indicators that the rudder is central. Keeping the aircraft straight and level with the elevator and aileron controls, check any tendency to yaw with the rudder control and trim out control load (i.e. center the ball). With the hall centered, check any tendency to roll with the ailerons and trim out load (i.e. center the needle).

Engine Failure During Cruise

In the event of loss of one or two engines, follow the procedure laid down in the cruise control section of the Manual, altitude being dictated by circumstances and ATC requirements.

FUEL

Fuel consumption checks should be made at intervals by reference to actual times achieved and flight plan times, actual consumption rates and planned consumption rates.

FLIGHT IN ADVERSE WEATHER CONDITIONS

Turbulence (Ref. Figure 6)

Areas of suspected turbulence should be avoided. If this is not possible, it is better to prepare the aircraft to encounter turbulence before it occurs, rather than when it occurs. In cumulo-nimbus cloud downdrafts are usually not so strong as updrafts and their velocities diminish towards the lowest levels of the storm. These downdrafts, however, can extend below the base of the cloud and continue very close to the ground, although it is unlikely that an aircraft flying 2,000 ft. above level terrain would be carried into the ground.

There is a relationship between rain fall and downdrafts, and if heavy rain is met below cumulo-nimbus a loss of height may be expected.

In thunderstorms rapid pressure variations can occur, and the instruments which depend upon atmospheric pressure, particularly the altimeter and rate of climb indicator, may give faulty readings due to this effect. The misreadings of the altimeter however are too small to be of operational significance.

Safety Speed

The rough air graph should be consulted for exact speeds. Attempts to fight changes of height and the making of turns increase the strain on the control surfaces and may result in the aircraft adopting a dangerous attitude. If control is lost, even temporarily, the subsequent recovery may cause a serious structural failure. For this reason, it is safer to avoid any coarse movement of the controls, to let the aircraft ride the storm, and to maintain the same heading.

If possible when committed to flight in turbulence, decrease the power and settle down to flight at penetration speed while still in smooth air. In any event, do not raise the nose to reduce airspeed once turbulence is encountered as this will serve only to increase the effect of gusts. Having obtained penetration speed, maintain attitude. Do not change the airspeed. Use the power levers only if the airspeed is tending towards the upper or lower limits.

Do not correct for altitude gained or lost in up or down currents unless absolutely necessary for terrain clearance.

Approaching an area of unavoidable turbulence:

1. Reduce power to obtain the correct penetration speed.

2. Check all occupants strapped in.

3. At night turn up the cockpit lights.

Should a situation arise where the aircraft enters a storm cell, then:

1. One pilot must devote all his attention to flying the aircraft; he should concentrate on maintaining a level altitude using as little elevator control as possible.

2. Remember:

   a. Fly attitude

   b. Do not chase airspeed

   c. Do not correct for altitude gained or lost unless vital for terrain clearance.

3. a. Maintain the original heading. It is certainly the quickest and often the safest way out.

   b. Buffet Onset Boundary (Ref. Figure 6)

   The design flight load acceleration limits may not be obtained under all flight conditions without encountering objectionable buffet. The onset of buffet varies with airspeed, altitude, aircraft weight and normal acceleration, as illustrated in Figure 4.

   The example shows that a Mach Number of 0.41 at 20,000 feet (185 knots IAS) and at a weight of 180,000 pounds, buffet will be encountered if the bank angle exceeds 55.5° (normal acceleration = 1.77).

   c. Rough Air Speed (Ref. Figure 7)

   In order to minimize the effect of turbulence on the airframe when rough air is encountered, the aircraft should be flown at the appropriate speed corresponding to the weight as given in Figure 5.

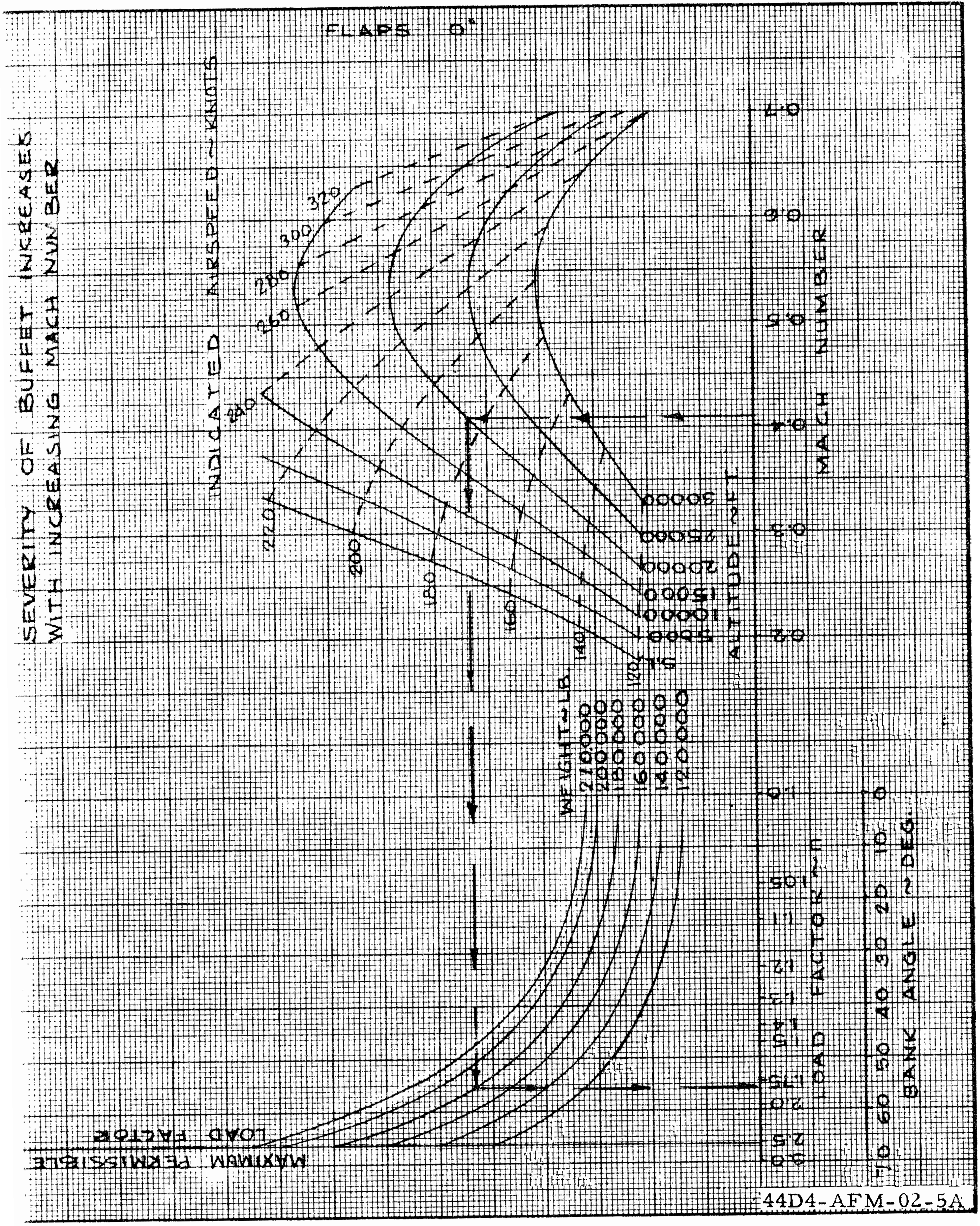
   The example shows that for a weight of 185,000 pounds, the recommended rough air speed is 209 knots IAS.

Take-Off and Landing

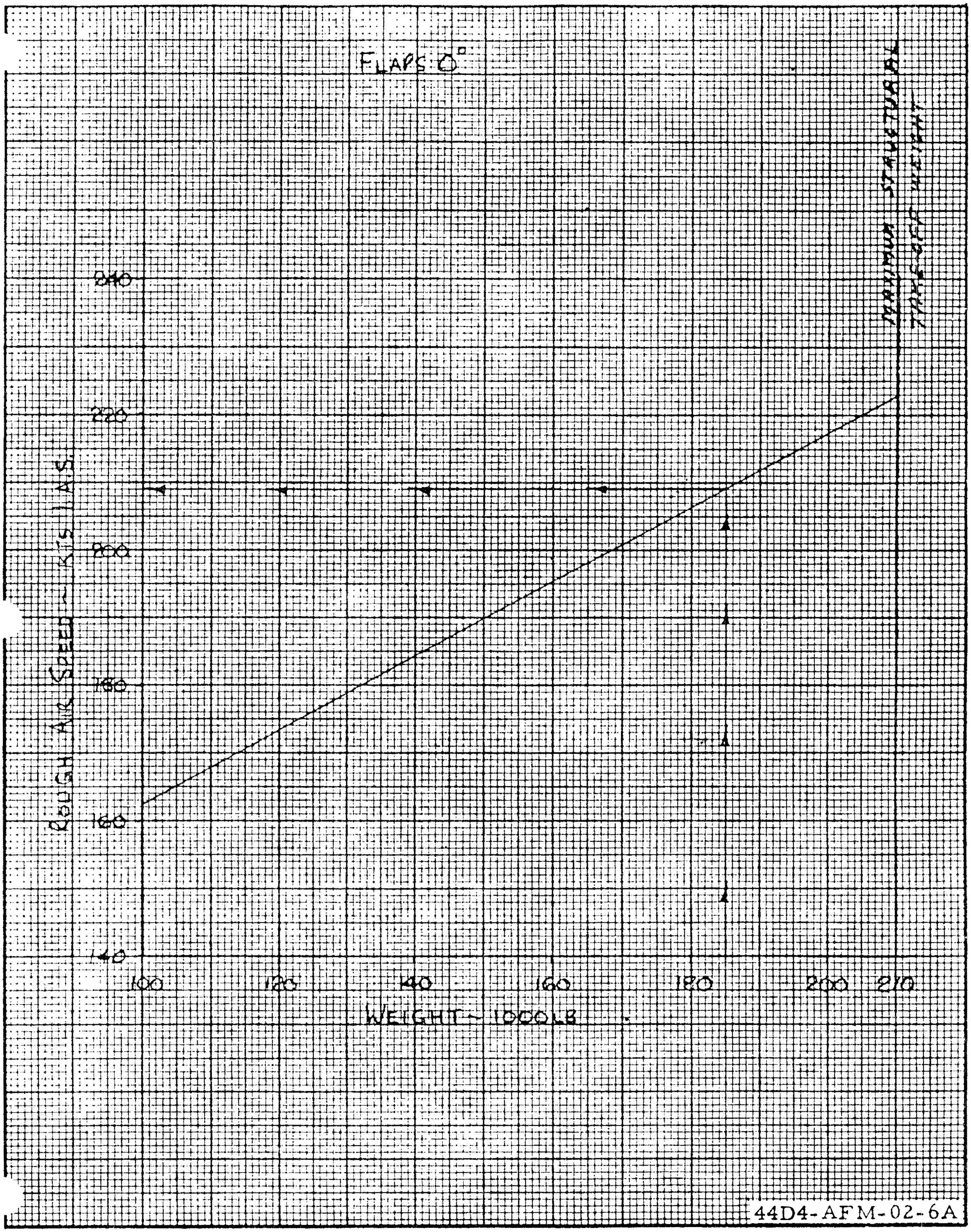
If there is any risk of the aircraft flying into the influence of an active thunderstorm during initial climb it is advisable to delay take-off. Similarly, if other operational considerations are not critical, it is advisable to delay approach and landing. In this connection it should be remembered that the severe wind shifts, often associated with cumulo-nimbus clouds, may result in instantaneous changes of airspeed which may being the aircraft, momentarily, dangerously close to the stalling speed.

Lightning

Lightning may occur in or beneath cloud, or between two clouds, No physical danger exists to the occupants of a correctly bonded metal aircraft, but there is a danger that the disconcerting effects, particularly of dazzle, may lead to loss of control unless the pilots are fully prepared. At night the cockpit lights should be fully on and one of the pilots should concentrate on looking away from the windshield for protection against the blinding flash. Lightning strikes may also cause large and variable deviation to appear in the compasses.



Buffet Onset Boundary
Figure 6



Rough Air Speed (V_{RA})
Figure 7

NORMAL FLIGHT HANDLING PROCEDURES

Hail

Hail damage can be severe. Hail forms in the chimney of a cumulo-nimbus above the freezing level. After hail has formed it overflows the cloud and falls down the sides in the surrounding clear air where there are no vertical currents to support it. The worst hail is usually encountered around the main cloud and underneath the over-hanging shelf rather than in the core of the storm. In the U.S. Weather Bureau's hail summary, it was pointed out that hail encounters below 10,000 ft. were predominantly within 2 miles or less of the storm. Between 10,000 ft. and 20,000 ft. hail encounters ranged up to 6 miles from the storm. Any time a storm is changing shape fairly rapidly, chances of hail shafts are excellent, and severe turbulence is almost assured. When using radar to fly through storm areas probable hail can sometimes be identified by the following echo patterns:

1. Pointing fingers

2. Hooked fingers

3. Scalloped edges

If possible, fly at least five miles from storms below freezing level, and at least 10 miles from storms above the freezing level exhibiting the above characteristics.

Avoid by at least 10 miles any storm which is changing shape rapidly, and fly well clear of any rapidly developing storm echoes.

If hail is encountered, the engine should be handled with care for the remainder of the flight in case damage has occurred to the inlet guide vanes. Heavy rain or hail may reduce IAS reading by partially blocking the pitot tubes.

DESCENT APPROACH AND LANDING

Descent

Before commencing descent, the descent check should be completed and both operating pilots should fit their shoulder harness and lap strap. If the operating pilots cannot reach the controls with shoulder harness fitted, the side retaining lock may be left in the "unlocked" position.

The rate of cabin descent should normally be limited to 300 ft./min. and should not exceed 500 ft./min.

At all times during the descent both pilots should be fully aware of the aircraft's altitude. Careful cross checks of altimeter readings must be made at 5,000 ft. intervals during the descent, and crosschecked against safety altitudes. Remember that ATC clearances do NOT guarantee safe terrain clearance. When cleared below the transition level reset altimeters to QNH, and when cleared to land crosscheck QNH on the altimeters.

Reduce power to flight idle, increase speed in descent to VMO. Take care not to exceed this figure.

The design flight load acceleration limits may not be obtained under all flight conditions without encountering objectionable buffet. The onset of buffet varies with airspeed, altitude weight and normal acceleration. Refer to buffet onset boundary chart, Figure 6. As an example:

M = .41
Alt. = 20,000
Speed = 185 IAS
Weight = 180,000 lbs.

In a sustained turn with an applied G of .77 (1.77 total), buffet will be encountered, max. 2.2 G (or a 55° bank turn).

Buffet can be stopped by relaxing pressure on the control column (and allowing controls to return to neutral position) and recovering from the turn.

It could also be initiated on descent if limiting mach number is exceeded and excessive G forces are exerted to recover.

Holding

In the interest of economy holding should be effected at as high an altitude as circumstances permit. At lower altitudes in confined air spaces, speed may be reduced to 170 kts., with clean aircraft, or 150 kts. with use of 15° flap. Hold clean at 170 kts. for maximum fuel economy.

Field Approach (In Range Check)

Complete field in range check list at approximately 10 miles range or before abeam of runway if making circuit. This includes a check of landing weight and threshold speed. A note will also be made of V_2, V_{FR} and VBC in event of an overshoot. Any special briefing on the let down, overshooting, etc., should be given at this time.

Instrument Procedures

The discussion on crew co-operation which prefaces this section applies with perhaps even greater emphasis during instrument let-down. The Captain must ensure before the procedure is commenced, that the First Officer has a clear idea of his plan of campaign, the action to be taken in the event of a missed approach and the propeller reversing plan. Both pilots should have studied the relevant let-down procedure and made any necessary notes on the approved procedures.

For all instrument procedures tune all radio aids for maximum assistance. Both ILS sets should normally be tuned for an ILS approach in order that the transfer switches may be operated without delay in the case of equipment failure.

NOTE: All transfer switches should be left in the normal position except in the event of such equipment failure.

The pilot who is not flying the aircraft should monitor the procedures checking all speeds and heights and must warn the pilot flying if any departure from the planned clearance is made. As minimum altitude plus 500 ft. is reached, the pilot not flying the aircraft should call clearly, using the standard phrase, "Minima plus 500", and again when minimum altitude plus 100 feet is reached. When decision height or minimum descent altitude is reached he should so advise. As minimum altitude is approached, the pilot not flying the aircraft should search for the runway or lights, and on seeing them clearly should so report and advise their direction relative to the nose of the aircraft.

Instrument Approach

At all times crosscheck indications on Captain's and First officer's instruments. The following configurations and speeds are recommended for a four and three-engine instrument approach.

The in range check should be completed and 15° flap extended before leaving the holding fix or before passing the outer marker outbound.

On ILS approaches do not select ILS mode on the approach horizon until the localizer is intersected on the inbound heading. The steering needle is used as a primary approach aid.

1. Mainain 150 kts. until completion of procedure turn and thereafter maintain posted speed IAS minimum.

2. Carry out landing check while on procedure turn.

3. As glidepath is intercepted, lower 30° flap and maintain approach speed until visual contact is established with the runway, or minimum approach altitude is reached.

4. The time inbound from the outer marker should be carefully checked.

If an LF range or NDB procedure is carried out, the same procedure will apply, descending to height shown at outer marker, and to minimum thereafter.

If circling approach is to be made, continue the approach from the radio facility, maintaining a minimum speed of 140 kts.

On a two engine instrument approach, maintain 150 - 160 kts. with 15° flap. Leave the landing check until after completion of procedure turn. Lower 30° flap on glide path interception and maintain 140 kts. minimum until contact. Full flap only when landing assured. If a circling approach is to be made on two engines, continue the approach maintaining 150 - 160 kts. from the radio facility, leaving the gear extension and 30° flap until on base leg. Ensure the landing check is completed.

Automatic Pilot Coupled Operation

This approach must be carefully monitored. The coupler can be engaged at any time after establishing a localizer intercept heading within 45° of the ILS QDM and not more than 10 miles from the transmitter. However, the smoothest results are obtained by maneuvering the aircraft in the SET HEADING mode until within 1 dot localizer displacement and a few degrees of the QDM then engaging the LOCALIZER mode. For more detailed information about manipulation of the auto pilot coupler for ILS approach and for operation of the flight director reference should be made to the appropriate pages in the operating manual. Auto pilot must not be used in asymmetric conditions.

Visual Approach

For details of the circuit, approach and landing checks and procedures, refer to Figure 8. It is desirable that the procedures and speeds for visual or instrument approaches be as similar as practicable.

Landing

The pilot will handle the power levers throughout the approach and landing; maintain 150 - 160 kts., IAS with 15° flap until gear lowered and flap setting increased; complete the landing check on the downwind leg (landing lights are extended on the landing check, and should be switched on by the pilot when required, normally at about 500 ft.). With 30° flap extended a minimum speed of 135 kts. should be maintained until turning on final approach at 800 - 1000 ft. When satisfactorily positioned for landing at a speed of 130 - 140 kts. full flap should be selected at about 200 ft. and speed reduced to cross the threshold at the speed appropriate to the weight.

Lowering full flap reduces IAS by approximately 10 kts. This flap drill accustoms the pilot to the conditions which will face him on breaking cloud at minimum height on an instrument approach.

On the flare out, the pilot will reduce power to FLIGHT IDLE. Harsh movement of the controls should be avoided during the flare and hold-off.

After touchdown, as soon as the main wheels are rolling, the pilot will ease the nosewheel onto the ground, hold the control column forward and call GROUND.

The First Officer will move the air/ground lever into the GROUND position, signifying this by calling GROUND, and take over the control column maintaining forward pressure.

The pilot will retard the power levers into the GROUND IDLE position, and when the engineer calls "All Beta lights on", he may then apply further reverse thrust as required, keeping the aircraft straight by use of coarse rudder, assisted by nosewheel steering as necessary. Select flaps up to increase effectiveness of brakes and nosewheel steering and lock controls when convenient bearing in mind runway conditions and aerodynamic effects.

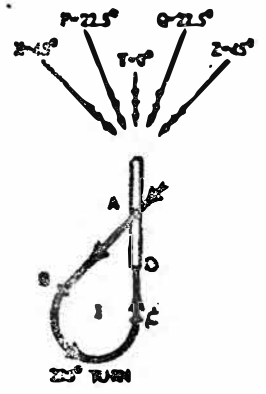
T.A.S. 140 KTS.

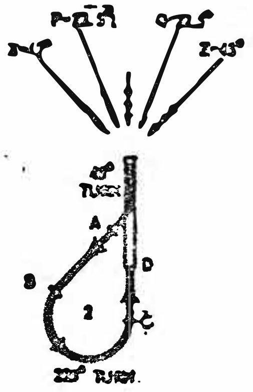
1. THE TABULATIONS BELOW GIVE THE TIMING FOR THREE DIFFERENT APPROACH PROCEDURES USING THREE DIFFERENT WIND VELOCITIES, AT VARIOUS R/W WIND ANGLES.
2. COURSE LINE IS SHOWN WITH SINGLE ARROW. WIND DIRECTION WITH TREBLE ARROWS.
3. CALCULATIONS BASED ON RUNWAY LENGTH 6000 FT.

EXAMPLE: ~~45N2-140~~ KNOTS PROCEDURE.
WIND DIRECTION 45° TO RUNWAY FROM 'Z' AT 20 KTS. PROCEDURE 3 IS BEING USED FROM THE TABULATION UNDER 45°, WIND DIRECTION 'Z', SPEED 20 KNOTS, WE OBTAIN THE FOLLOWING INFORMATION:-

A TO B - HOLD COURSE FOR 8 SECONDS
C TO D - HOLD " " 20 "
E TO F - HOLD " " 43 "

NOTE THAT ON FINAL APPROACH (E-F), ALLOWANCE SHOULD BE MADE FOR 6° PORT DRIFT.





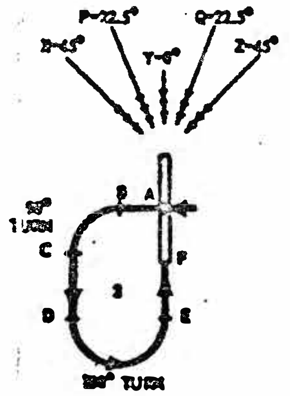


Figure 8

Procedure 1

WIND ANGLE TO RUNWAY 0° - Y		
WIND SPEED KNOTS	A-B	C-D
10	47	40
20	46	46
30	46	54

WIND ANGLE TO RUNWAY 22½° - P AND Q					
	P		Q		
WIND SPEED KNOTS	A-B	C-D	A-B	C-D	DRIFT FINAL APPR.
10	51	49	42	41	2°
20	56	64	38	43	3°
30	63	58	34	57	5°

WIND ANGLE TO RUNWAY 45° - X AND Z					
	X		Z		
WIND SPEED KNOTS	A-B	C-D	A-B	C-D	DRIFT FINAL APPR.
10	53	53	33	35	3°
20	64	71	31	37	6°
30	74	92	25	32	9°

Procedure 2

WIND ANGLE TO RUNWAY 0° - Y		
WIND SPEED KNOTS	A-B	C-D
10	39	65
20	38	56
30	35	65

WIND ANGLE TO RUNWAY 22½° - P AND Q					
	P		Q		
WIND SPEED KNOTS	A-B	C-D	A-B	C-D	DRIFT FINAL APPR.
10	43	57	34	50	2°
20	40	76	29	53	3°
30	55	101	25	67	5°

WIND ANGLE TO RUNWAY 45° - X AND Z					
	X		Z		
WIND SPEED KNOTS	A-B	C-D	A-B	C-D	DRIFT FINAL APPR.
10	47	57	30	43	3°
20	53	82	22	46	6°
30	69	105	16	43	9°

Procedure 3

WIND ANGLE TO RUNWAY 0° - Y			
WIND SPEED KNOTS	A-B	C-D	E-F
10	19	25	42
20	19	18	45
30	19	13	48

WIND ANGLE TO RUNWAY 22½° - P AND Q							
	P			Q			
WIND SPEED KNOTS	A-B	C-D	E-F	A-B	C-D	E-F	DRIFT FINAL APPR.
10	23	23	41	16	24	41	2°
20	26	15	44	13	16	44	3°
30	29	7	48	18	10	48	5°

WIND ANGLE TO RUNWAY 45° - X AND Z							
	X			Z			
WIND SPEED KNOTS	A-B	C-D	E-F	A-B	C-D	E-F	DRIFT FINAL APPR.
10	26	25	40	13	36	41	3°
20	33	18	43	8	22	43	6°
30	40	11	45	3	14	45	9°

Although brakes may be used during any part of the landing run at the pilots discretion, it is advisable, if runway length available permits, to use them sparingly, and to restrict their use, if possible, to below 55 kts.

On any landing with anti-skid inoperative, the brakes should be used with extreme caution to avoid blowing tires. Use reverse thrust to maximum advantage.

The after landing check list should be completed when the aircraft has slowed down to normal taxi speeds and is clear of active runways.

NOTES:

1. Elevator trim should be trimmed slightly nose up before the flare. This will provide assistance to the servo tabs and thereby increase the effectiveness of the elevators, especially in forward C of G conditions.

2. In windy or turbulent conditions, the pilot should be prepared for the effects of the wind gradient over the last part of the final approach, and it is advisable to increase the above approach and threshold speed by 5 - 10 kts.

3. Power must not be applied in reverse thrust unless the appropriate BETA warning light gives a steady illumination.

4. GROUND IDLE position is a flat pitch position of the propeller, and provides considerable drag during the initial part of the landing run. This is normally sufficient to slow the aircraft down without further use of reverse thrust (unless runway is limiting). When using reverse thrust it should be borne in mind that damage by ingestion and scoring of the propeller can result if used at low airspeeds, and forward vision can be obliterated under adverse weather conditions, by blowing snow, water, etc., ahead of the aircraft.

5. The scheduled landing distances are based on the aircraft being at 50 ft. over the threshold at the appropriate threshold speed and with the power levers at idling. Under these conditions the landing distance required will not be more than 60% (70% at alternates) of the length of runway using brakes and GROUND IDLE only. Chart of threshold and safety speeds is on the back of the general check list.

Braking

Maximum braking is obtained when the wheels are braked without skidding. This is accomplished by the anti-skid system which relieves brake pressure automatically before a skid develops. Thus on a landing, brakes must never be applied before the main wheels are rolling, with the nosewheel firmly on the ground, as the wheels may make contact with the runway in a locked condition, resulting in a badly scuffed or burst tire.

The wheel brakes are very powerful and to avoid damaging the tires it is recommended that at higher taxiing speeds, brakes should be used very lightly.

Brakes should be used sparingly where runway length available permits, to reduce wear and tear on brakes and wheels.

With the anti-skid system inoperative brake application should be made with extreme caution when on the landing run, and only in the lower speed range (below 55 kts.), if possible, or by fast, light, pumping action.

Total loss of normal pressure supply will leave only brake accumulator pressure. If both brake accumulators are fully charged, approximately 10 full brake pressure applications are available.

Hydraulic pressure can be delivered by the auxiliary pump or in the case of the hand pump to the brake accumulators by the following procedure.

Hand pump manual selector	LG emergency & brake accumulator
Hand pump selector switch	Emergency brake
Nosewheel steering switch	OUT
Anti-skid	OFF
Hand pump	Operate

(In this case steering would be effected by differential brake, and if necessary, by differential engine.)

In cases of aborted take-off and overweight landings, the waiting time before further brake application will depend on severity of braking. In severe cases allow 45 minutes. This will allow the brake plates to cool and, therefore, ensure adequate temperature reserve in the wheel brakes and tires to recommence taxiing and carry out another take-off.

If heavy braking was applied either on the aborted take-off case at high speeds or on an overweight landing, wait for 45 minutes before attempting a further take-off.

It is preferable to leave the hand brake off in this instance, during the quoted waiting period, and certainly during the first few minutes, ensuring that chocks have been placed fore and aft of the main wheels. Waiting time is designated as engines off to commencement of taxiing.

When parking the aircraft on the ramp, the parking brake must be applied and must not be released until it has been positively established that chocks have been placed in position fore and aft.

Standard Reversing Drill

	Brake Application	Waiting Time
1. After normal landing	Heavy	20 mins.
	Light	15 mins.
	Not used	10 mins.

NORMAL FLIGHT HANDLING PROCEDURES

(Cont'd)	Brake Application	Waiting Time
2. After rejected heavy take-off from brakes, on IAS less than 70 kts.	Heavy Light Not used	45 mins. 30 mins. 15 mins.
3. After rejected take-off from brakes, on IAS greater than 70 kts, or overweight landing.	Heavy Light Not used	*See below 45 mins. 15 mins.

Non-standard Reversing Drill (i.e. wheel brakes only)

1. After normal landing	Heavy Light	30 mins. 20 mins.
2. After rejected take-off from brakes, on IAS, less than 60 kts.	Heavy Light	45 mins. 30 mins.
3. After rejected take-off from brakes, on IAS, greater than 60 kts., or overweight landing.	Heavy Light	*See below 45 mins.

* In the event of using heavy braking either on aborted take-off at high speeds or on overweight landing, the following procedure will be carried out.

1. Taxi aircraft back to ramp. Judicious use of brakes.
2. Park away from adjacent aircraft, personnel and buildings.
3. Parking brake off. Main wheels chocked fore and aft.
4. All personnel must keep clear of the aircraft for at least 60 minutes.
5. Suspected fire: fire personnel only to approach the affected undercarriage from fore and aft, not from the sides.

MISSED APPROACH

In the event of having to go round again, the following procedure should be carried out.

	Captain	First Officer	Flight Engineer
1.	Orders "Missed approach". Sets full power smoothly, advancing the power levers. Increases speed from 1.2 V_S to V_2 & orders 15° flap.	Follows through on power levers & with full power set applies friction lock. Calls "Full power set" & retracts flaps to 15°.	Adjusts condition levers.

	Captain (Cont'd)	First Officer	Flight Engineer
2.	When initial climb is established calls "Gear up" and raises gear. Climbs at V_2 if obstruction clearance required, otherwise allows speed to increase to minimum flap retraction speed, and -	Reports "Gear up".	
3.	At 400 feet orders "Flap up".	Selects flaps up and reports when up.	
4.	Orders required power at a safe altitude and accelerates to best climb speed.	Selects required power and reports VBC	Adjusts condition levers.
5.	Orders "After take-off check".	Completes after take-off check.	

THREE ENGINE LANDING

The approach and landing on three engines is identical to that used when on four engines, except that where threshold speeds are below 115 kts., according to AUW, 115 kts. should be used to ensure controllability. The flaps should not be extended beyond 30° until the landing is assured. After landing, power levers of the three good engines should be placed to GROUND IDLE and reverse thrust used on the two symmetrical engines as required.

Three Engine Missed Approach

This procedure is similar to that used when on four engines, except that three engine best climb speed is used when applicable.

TWO ENGINE LANDING

The circuit approach, and landing is similar to that used on four engines, except 30° flap selection delayed until on final approach.

The normal angle of approach should be maintained, taking care not to get LOW. Maintain a minimum speed of 140 kts. and do not select full flap until it is certain that the runway can be reached. Flap should then be lowered fully, and power reduced to cross threshold at a minimum speed of $1.3\ V_S$ / 45° flaps.

When firmly on the ground, GROUND IDLE and reverse thrust should be used consistent with the preservation of directional control.

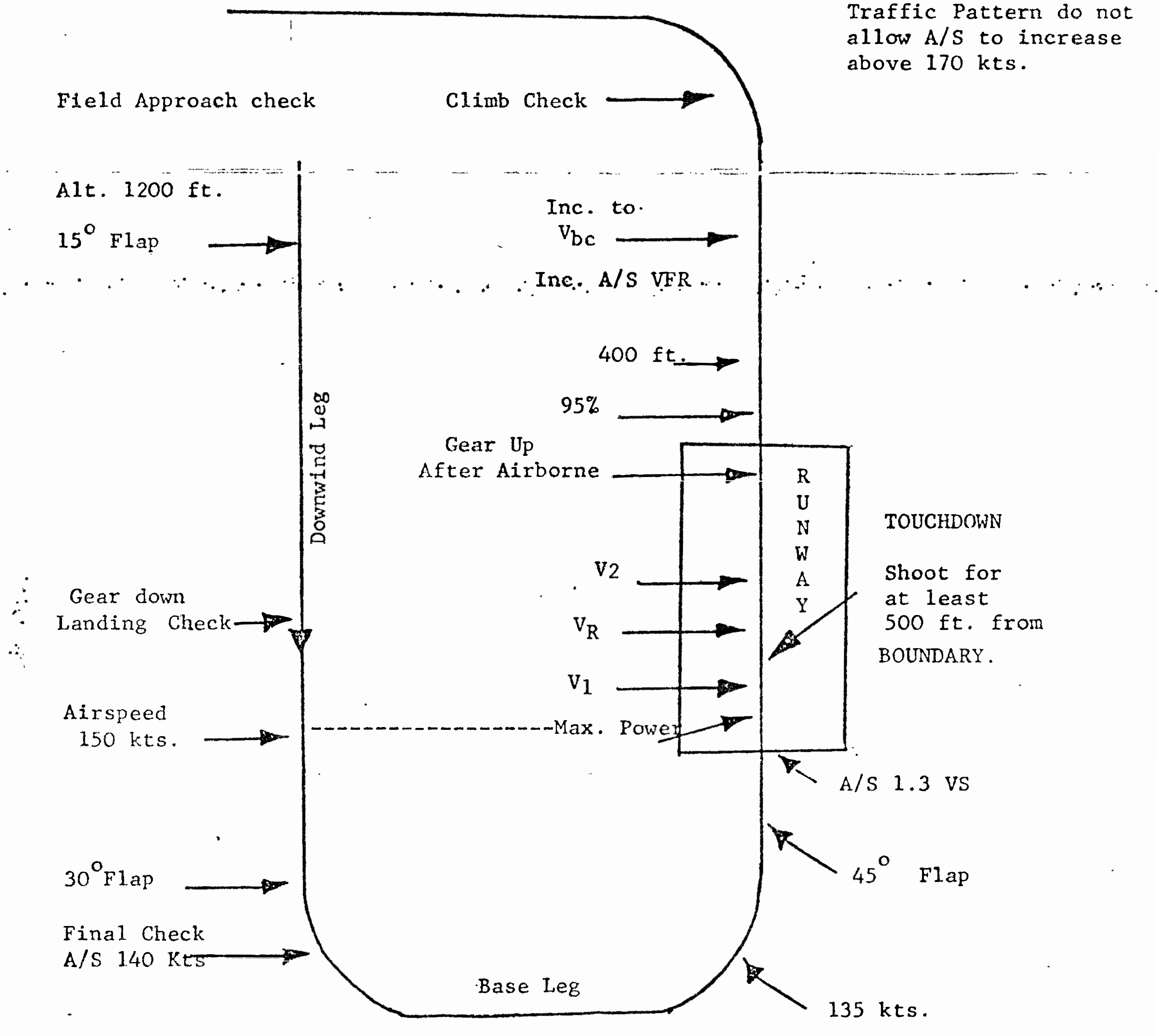
Thus with asymmetric engines remaining, use reverse thrust only on the inboard engine, with symmetric engines, reverse thrust may be used on both if required.

FLIGHT TRAINING GUIDE

NORMAL TAKE-OFF AND LANDING DIAGRAM

4 AND 3 ENGINE

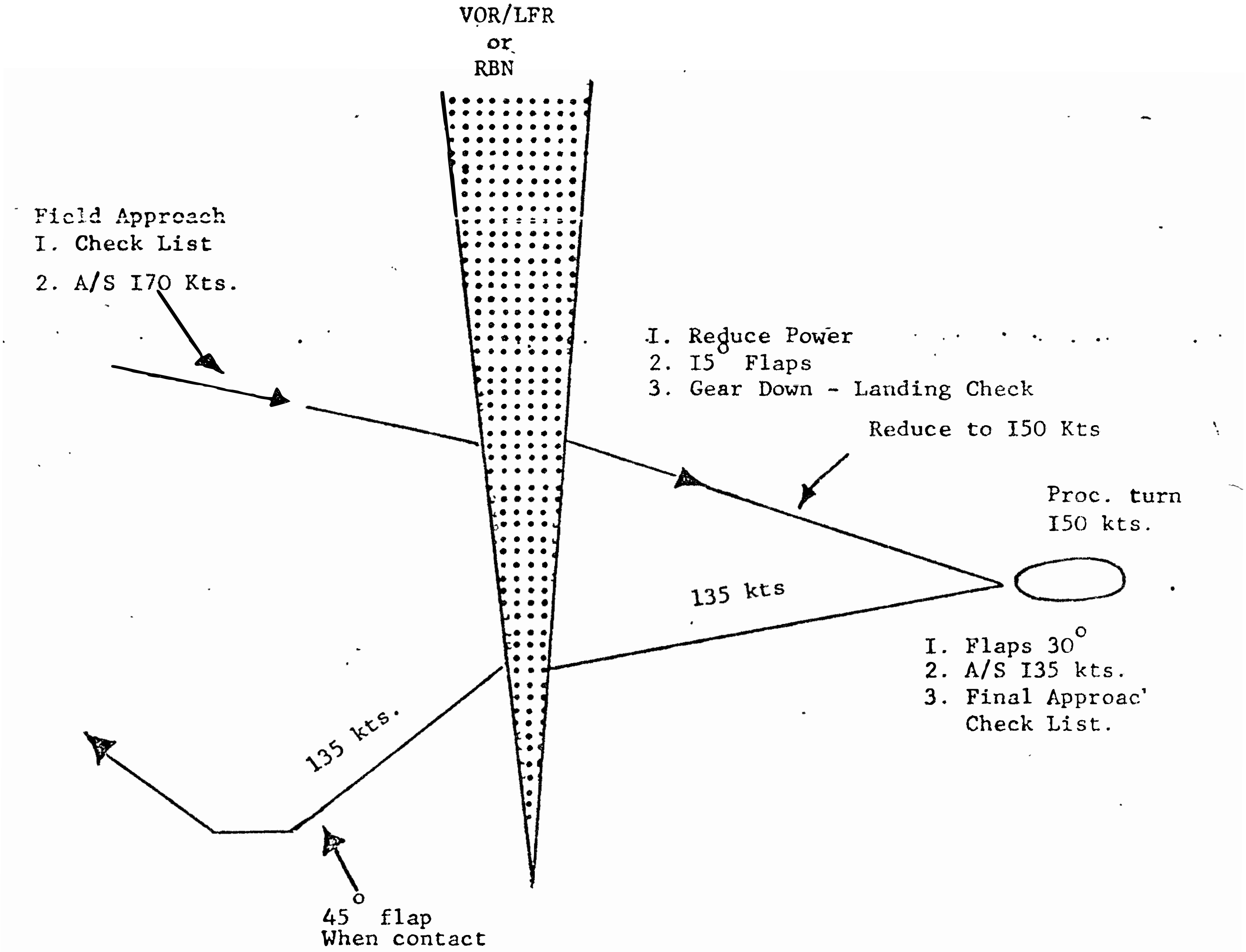
NOTE: When staying in Traffic Pattern do not allow A/S to increase above 170 kts.



DO NOT EXCEED 30° BANKS IN PATTERN

Figure 9

VOR/LFR/ADF Procedures



Missed Approach
I. Max. Power
2. I5° Flap
3. Up Gear

Figure 10

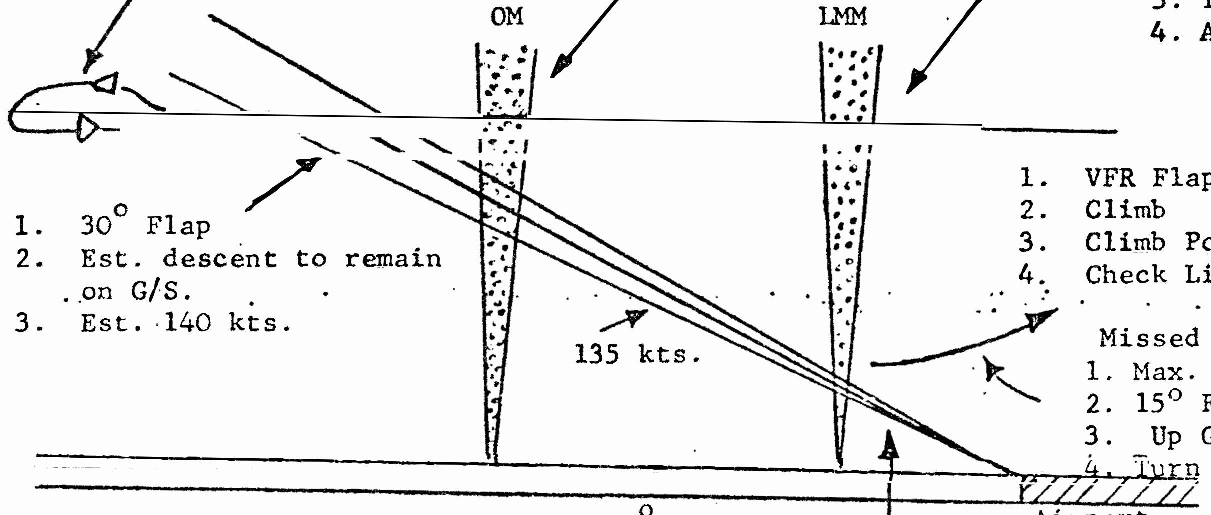
FLIGHT TRAINING GUIDE

1. Proc. turn outbound
   A/S 150 kts.
2. Final Approach check list.

STANDARD ILS APPROACH
4 or 3 ENGINE

1. Gear down-Landing check
2. Reduce to 150 kts. by time of starting procedure turn.

1. Field approach check.
2. Reduce Power
3. 15° Flaps
4. A/S 170 kts.



1. VFR Flaps Up
2. Climb
3. Climb Power
4. Check List

Missed Approach
1. Max. Power
2. 15° Flaps
3. Up Gear
4. Turn knob from ILS HDN

1. 30° Flap
2. Est. descent to remain on G/S.
3. Est. 140 kts.

135 kts.

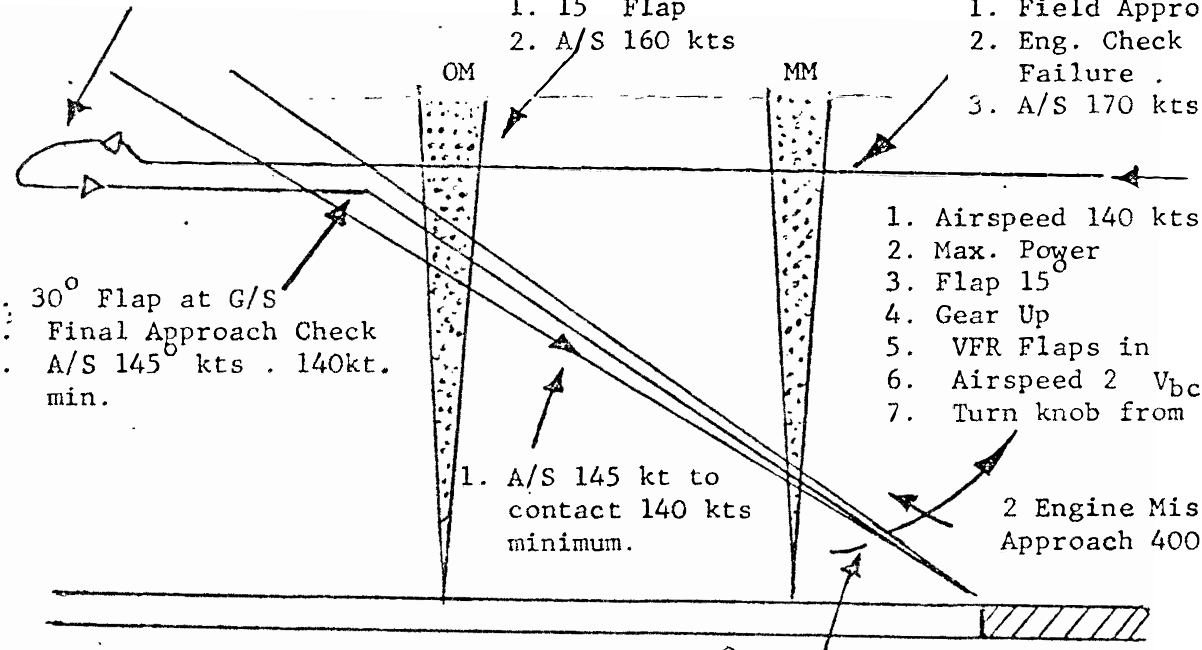
1. Select 45° Flaps wgen contact

Proc. Turn
1. Gear Down-Landing Check.
2. A/S 155 kts.

ILS APPROACH
2 ENGINE

1. 15° Flap
2. A/S 160 kts

1. Field Approach check
2. Eng. Check for Hydrauli Failure .
3. A/S 170 kts.



1. Airspeed 140 kts. min.
2. Max. Power
3. Flap 15°
4. Gear Up
5. VFR Flaps in
6. Airspeed 2 V_{bc}
7. Turn knob from ILS to HDNG

1. 30° Flap at G/S
2. Final Approach Check
3. A/S 145° kts . 140kt. min.

1. A/S 145 kt to contact 140 kts minimum.

2 Engine Missed Approach 400 min.

1. Select 45° Flap when contact
2. Reduce to VOF

Figure 11

Two Engine Missed Approach

The decision to go around (missed approach) when on two engines should be made above 400 feet, before flap has been lowered more than 30°, and at a minimum speed of 140 kts.

Having decided to go around (missed approach) the following procedure will be carries out:

	Captain	First Officer	Flight Engineer
1.	Orders "Missed approach set full power, flaps 15° and smoothly advance the power levers.	Follows through on power levers, and with full power set, applies the friction lock. Calls "Full power set".	Adjusts condition levers.
2.	Orders "Gear up" and retracts gear, climbs away initially at 140 kts.	Reports "Gear up".	
3.	Allows speed to increase to minimum flap retraction speed, and above 400 feet orders "Flaps up".	Selects flaps up, and reports "Flaps up".	
4.	Increases speed in the climb to 2-engine best climb speed, and at a safe altitude orders climb power (95%).	Selects climb power.	Adjusts condition levers.
5.	Orders "After take-off check".	Completes after take-off check.	

NOTE: If both port engines are inoperative, total loss of engine driven hydraulic main pressure supply will result. To raise gear on overshoot, utilize electric hydraulic pump (time to raise gear is approximately doubled).

FLAPLESS LANDINGS

The flapless landing procedure does not present any undue difficulty apart from the fact that the clean aerodynamic lines of the CL44 make it difficult to reduce airspeed.

The final approach, longer and flatter than normal, should be made at 1.25 V and the threshold crossed at this speed. Check the descent, and with idling power settle the aircraft on the runway. Avoid prolonged hold-off. It is possible to contact the ground with the tail, damaging it. Lower the nose wheel smoothly as soon as possible and keep it on the ground by holding the control column forward of neutral.

Select reverse thrust as required. Use rudder only for directional control in the early stages of deceleration. At the high speeds used on flapless landing, rudder control is more than adequate, and nosewheel steering is very light and over sensitive. The minimum runway length considered acceptable for flapless landing in zero wind is 9,000 ft. or 8,000 ft. with a 15 kt. headwind, depending on temperature and aerodrome altitude.

CROSSWIND LANDINGS

There are two systems or a combination of the two commonly used to eliminate drift in crosswind landings, namely, where the aircraft is flown in a crab with wings level, and where a wing is lowered throughout the approach. In the first system the drift angle is theoretically removed just prior to contact by changing aircraft direction. The latter method compensates for drift by lowering a wing on the windward side.

1. Crab: The technique does not involve wing-tipping or lowering of a wing on one side to correct for drift; merely apply the correct drift angle to track the center of runway.

   . Apply the correct crab angle to track the center of runway. Just before point of estimated contact, turn aircraft with downwind rudder to eliminate crab. Remove the crab at a conservative distance from the estimated contact point. This causes a slight additional drift to occur. However, the slight drift that is now apparent is not serious and can be corrected by a very small change of direction. In a strong crosswind, the possible advantages of using a setting of 30° flap for landing should be borne in mind. This technique will assist in getting the aircraft onto the runway as quickly as possible and so reduce the time during which the aircraft is again subject to drift once the crab has been removed.

2. Side-slip: Make the approach from a normal position at regular approach speed and line up straight with runway. Drop the wing slightly on the upwind side. Top rudder is necessary to hold direction. You are now in a slight sideslip attitude. The amount of aileron and rudder depends on the degree and velocity of crosswind. Flare-out normally with wing still down. Before contact, unless a very strong crosswind exists, raise wing so that both wheels contact runway smoothly and in correct attitude. With strong winds contact on one wheel is made. Then the other wheel and nosewheel lowered promptly.

3. Combination sideslip and crab: In this method the aircraft is mainly slipped with rudders. This process requires the upwind wing to be lowered and opposite rudder held to prevent aircraft from turning. In other words crossed controls. Crab is removed and normally the wing leveled just before landing. Residual inertia will prevent drifting until contact is made. However, in extreme crosswind, landing on the one upwind wheel is made. Maintain flying speed until contact is made and lower nosewheel promptly. (Every effort should be made to avoid landing on the downwind wheel). The same technique can be used on the ground in crosswinds. On a take-off or landing roll, aileron into the wind and opposite rudder will materially aid in controlling direction, will keep wings level and

thus eliminate the side-scuffing sensation and tire wear. Naturally, the amount of crosswind control will vary inversely with the airspeed and thus constantly change. Remember that on the ground the aileron which is down exerts considerable drag while the one that is up has almost no effect. For example, with a crosswind from your right, the aircraft tends to turn right. If you then turn aileron into the wind)to the right) the left aileron is depressed and retards the left wind, which thus brings the nose to the left and back into alignment. This effect will continue throughout the roll if the aileron is thus held, reducing the amount of course, as speed increases. If this procedure is used on take-off roll, crossed controls are relaxed and upwind wing lowered slightly as soon as definitely clear of the ground. Correct crab will almost automatically result.

NOTE: Remember small propeller clearance and maximum crosswind component is 25 knots.

OVERWEIGHT LANDING

Landings at weights in excess of the maximum permissible are only allowed in an emergency. The main and nose undercarriage are designed to cater for emergency landings at maximum take-off weight, but with reduced energy absorption capacities. The remainder of the structure has a satisfactory margin of strength under the loads resulting.

According to the disposition of fuel and fuselage load, the stress concentration varies through the wing, fuselage and undercarriage structure, but broadly speaking the stress is no greater at 210,000 lbs. with a vertical rate of descent of 6 ft./sec. than it is at 165,000 lbs. at 11 ft./sec. for which the structure is designed.

The flaps, flap support structure and appropriate wing structure, have been designed to the placarded maximum lowering speed flap angle limitations with full strength margins for all take-off weights up to the maximum permissible. Extreme care must be exercised in selecting the correct approach and threshold speed for the appropriate weight, and every effort must be made to avoid landing with drift on.

Full flap should be used for landing. Landing up to 210,000 lbs. have been made during flight tests, and no unusual handling characteristics are apparent, but a baulked landing with engine failure could, of course, involve difficulties.

When a landing over maximum landing weight is made, an entry should be made in the technical log to this effect, which will include the AUW, the landing conditions, i.e. whether any crosswind component exists, and whether or not a heavy landing was made.

LANDING WITH FEEL SIMULATOR OUT

At high speed it is quite possible to impose excessive loads on the aircraft structure unless protection is afforded by the feel simulator. However, at circuit procedure speeds, the stick loadings imposed by the feel simulator are not very significant.

Should the feel simulator fail for any reason, as indicated by the warning light, a normal circuit, approach and landing should be carried out, but with the lighter stick loadings, great care must be taken to avoid harsh elevator control movements.

RUNWAY PROCEDURE

The runway procedures are designed to enable the pilot to align his aircraft in poor visibility with the runway once he has located the field, but finds himself not in line with the runway. Definite procedures are greatly to be preferred to a haphazard semi-visual circuit.

The tabulations on the following page give the timing for three different approach procedures using three different wind velocities at various runway wind angles.

NOTES:

1. The Captain will be responsible for maintaining not less than 500 ft. above aerodrome height or 300 ft. above obstruction height, whichever is the greater.
2. The angle of bank and the airspeed must be kept constant during port and starboard turns.
3. Power may have to be increased during the turns to maintain a constant airspeed.
4. All turns should be Rate 1.

Complete field approach check before reaching the field and assess drift from reported winds. The procedures must be carried out with the landing gear extended and flaps 30°, speed of 140 kts. In turbulent conditions engine power may have to be adjusted to maintain this speed. The flaps should be lowered to landing configuration at a-proximately 300 ft. when fully visual.

COLD WEATHER PROCEDURES

General

When aircraft are parked in winter conditions, snow, ice or frost may deposit on exposed surfaces. These can affect the aerodynamic properties of the aircraft and the all-up weight to a serious extent.

Before take-off, frost, snow or ice must be removed from tops and bottoms of the wings, center section and stabilizers, control surfaces, propeller blades, fuselage, pitot tubes and static vents. Frost, frozen snow or any deposit which presents a rough or uneven surface has the greatest effect on airflow especially if it is located on the upper surface of the wing forward of the 15% chord point. These deposits have the greatest effect at low speeds and high angles of attack such as occur at take-off. The danger is due mainly to an increase in stalling speed, perhaps to a figure exceeding the normal take-off speed. There is also the possibility of less effective elevator control affecting the take-off. Control of the aircraft may also be affected by any residual irregularities on partially cleared surfaces or by any lack of symmetry if some parts are thoroughly cleared and others are not.

The spaces between fixed and movable surfaces are extremely critical - deposits in these areas can cause binding of the controls.

If the airframe has been cleared of ice and the aircraft is then kept waiting for ATC clearance or landing aircraft, snow can again adhere to the wing and a careful watch must be kept in such circumstances.

In conditions of light to moderate snow with surface temperature just above freezing the falling snow turns to slush on the upper surfaces of the main and tail planes and may be seen melting and running off the trailing edge. Such conditions may appear satisfactory for take-off, but this condition can be dangerous if sufficient slush and moisture remain as the aircraft gathers speed, for temperature and pressure changes over the main plane can cause the moisture to freeze and upset the lift characteristics.

The landing gear and wheel wells must be checked completely free of ice, slush, or snow.

In extreme conditions it may be necessary to take account of the increase in emergency distance required in event of an aborted take-off.

Before Starting Engines (After Cold Soak)

1. External power - connected.

2. Wheel chocks - in place.

   Make sure that wheel chocks are placed securely so that danger of slipping will be minimized during engine start and warm up.

3. Brakes - set.

4. Windshield heat - On low 30 seconds, then off. Repeat twice. Then leave on.

5. Pre-heat engines if required.

CAUTION

IN COLD WEATHER, MAKE SURE THAT ALL INSTRUMENTS HAVE WARMED UP SUFFICIENTLY TO ENSURE NORMAL OPERATION. CHECK FOR SLUGGISH INSTRUMENT OPERATION DURING TAXIING.

NORMAL FLIGHT HANDLING PROCEDURES

Taxiing Instructions

Maintain a greater distance than normal from other aircraft when taxiing on ice or snow covered areas. Be especially careful in maneuvering near other aircraft. Avoid taxiing in deep snow or ice, as steering will be more difficult and brakes, gear and flaps may freeze after take-off. Do not taxi with flaps down. It is prudent while taxiing to avoid placing the aircraft in a position where it might be in the path of snow blown by another aircraft.

Use extreme caution when taxiing over ice-covered taxiways, as excessive speed or high crosswinds may start a skid. The use of propeller reverse can assist in slowing the aircraft. Caution should be used when on loose snow to ensure blown snow does not obscure vision.

It must be remembered that brakes and nosewheel steering will be less effective on icy ramps and, therefore, taxiing speed must be kept down to a safe figure. The speed should be lowered almost to a standstill before making major changes of direction. This will also prevent the wheels spraying slush over the flaps or wings.

It is very important to keep a close watch on outboard propellers in the vicinity of high snow banks.

Take-off on Wet, Slushy or Snow-covered Runways

The following information has been prepared using the best evidence at present available. It is intended for the guidance of captains whose final action must depend upon an assessment of the prevailing conditions, since it is not possible to cover by rule all the factors which may be involved.

It is emphasized that while the following conditions assume a contaminated runway throughout the take-off run, the effect is relatively small at a low speed. It is the state of the runway beyond, say, the first 2,000 feet which is the most important.

Water, slush or snow on the runway can have an adverse effect on an aircraft's take-off performance, due to:

1. Retardation effects on aircraft bogies running through the slush or water layer.

2. Drag due to impingement on the aircraft of spray thrown up by the bogies.

3. The possibility of power loss due to spray or snow ingestion.

4. Controllability difficulties.

5. Possibility of loss of structural damage to flaps, etc. caused by spray impingement.

Wet snow is always to be treated as slush because of the problem of predicting stopping distances with slush or water on the runway and of calculating a similar effect on the engine inoperative distance, it is not recommended that the V_1 speed be adjusted for take-offs with slush or water on the runway.

It is important, when operating from contaminated runways, that the position of the C of G of the aircraft should be at the optimum trim position so as to ensure a reserve of elevator power to facilitate the rotation of the aircraft.

Theoretical calculations and practical observations of the behavior of the aircraft taking off from contaminated runways, show that the increase in ground roll is considerably reduced if the nosewheel is lifted clear of the snow or slush and it is wise to adopt this procedure of lifting the nosewheel so as to unstick at up to 10% below the normal lift off speed. Care should be taken to avoid raising the nosewheel higher than necessary, thus introducing unnecessary excessive drag caused by high angles of attack.

Because of the loss of nosewheel steering caused by the operating technique mentioned above, and also because of the possibility of losing steering due to the onset of aquaplaning, particular regard should be given to the value of crosswind component that can be accepted and aircraft should not be taken off from contaminated runways when the crosswind component exceeds 12 kts.

After Take-off

1. Delaying the retraction of the wheels for a few seconds after take-off may be effective in removing slush from the assembly by the slipstream. Cycling the gear up and down after take-off lessens the possibility of the doors freezing shut because of the slush pick up, reduces the possibility of the bogie freezing in the rotated position. If a nose or main wheel fails to lock up after take-off and jamming by snow is suspected, the gear may be cycled in an effort to free the condition.

2. Engine guide vane anti-icing switch may be placed to NORMAL, after flaps have been retracted from take-off position.

3. Check anti-icing system cycling correctly.

4. Windshield heat to high if and when required.

In Flight

Flight at low airspeed in icing conditions should be avoided as far as possible. At low speeds the attitude of the aircraft is such that ice may be picked up on the underside of the wings and fuselage with consequent loss of performance. Freezing rain is dangerous and flight in these conditions should be avoided. For maximum protection against ice, the engine and propeller de-icing system should be activated at all times when OAT is below + 10° C, except when it is certain that icing will not be encountered.

Propellers and cowls de-icing switch	NORMAL
Engine guide van anti-icing switch	OFF
Ice protection master switch	ON
De-icing timer switches (3)	FAST (above 8° C) SLOW (below 8° C) MAIN NORMAL

The engine guide vane anti-icing switch should be switched to NORMAL when flight into expected icing conditions is anticipated, but must not be switched on when take-off power is required.

Anti-ice control switches for the wings and empennage should be checked in the NORMAL position and on receipt of an ice warning the indicator lights and temperature indicators should be monitored for proper operation.

For effective ignition of the horizontal stabilizer anti-icing heater at altitudes between 20,000 and 30,000 ft. observe the following maximum airspeed:

> 185 kts. IAS at 30,000 ft. increasing by 6 kts. IAS for each 1,000 ft. below 30,000 ft.

Approach

Do not hold in bad icing conditions, but if some ice has been picked up on the approach it is advisable to carry a small speed margin for unpredictable stall effects. However, the reduced deceleration available on wet or icy runways must also be borne in mind, in which case the required runway length may be increased. In these circumstances, limiting runways should be avoided if a suitable longer runway is available.

Ice protection systems will normally be switched off before landing. On final approach (approximately Outer Marker) the wing and empennage systems should be switched off unless some risk of an overshoot into icing conditions exists. The propeller and cowl system may be left on if necessary.

The emergency relight switch should be placed to RELIGHT to prevent loss of power after touchdown due to ingestion of slush or spray.

Too much water or slush on the runway can damage an aircraft on landing, and a report on runway conditions should be obtained before deciding to land. These reports should include the braking action, and the crosswind component.

It is also possible that the threshold lights and even some runway lights may be obscured by fallen snow.

If at any time ice accretion has occurred during flight, the aircraft should be cleared of ice, within the weather conditions prevailing, before landing.

NORMAL FLIGHT HANDLING PROCEDURES

Landing (3 and 4 Engines)

Extreme care must be taken when landing on runways contaminated by slush or snow remembering that it is most important to maintain directional control. A long approach should, therefore, be made along the extended center line of the runway.

Immediately after touchdown, every attempt should be made to maintain directional stability by aerodynamical means, using coarse rudder rather than by using power or brakes. Should aquaplaning occur, it is more than likely that during the early stages of the landing run, nosewheel steering and brakes will be of little use.

Limitations of the maximum crosswind component for landing will obviate the possibility of a swing occurring due to crosswinds, and therefore, normal reversing action should be used. However, it may well be that gusty conditions or sudden change in wind direction may create difficulties and, if a swing is detected which cannot be controlled by rudder alone, then reverse should be canceled, attempts made to control the aircraft path and when it is moving straight again, reselect reverse.

The nosewheel must, at all times, be pointed in the direction of desired travel.

Initial selection of reverse on badly contaminated runways may also deprive the pilot temporarily of visibility due to the pushing forward of spray. In this case, cancel reverse and reselect when visibility is regained.

Flaps should be retracted as soon as possible in the landing run to prevent possible damage from spray.

Use of Reverse Thrust with Loose Snow

Using reverse thrust at low speeds in conditions of loose snow can result in snow being blown ahead of the aircraft and reducing forward visibility. For this reason, whenever reverse thrust is used in loose or blowing snow, a careful check of the static parts should be made prior to the next take-off. The use of GROUND IDLE on loose snow at slow speeds will also tend to blow snow ahead of the aircraft. This recommendation is not intended to limit the use of reverse thrust whenever it is actually needed.

Stopping Engines

Use the normal procedure to stop the engines.

Aquaplaning

Aquaplaning is the effect that water on a runway has on an aircraft when it is moving at high speed over that runway, when either landing or taking off, and can seriously affect aircraft ground controllability and braking efficiency. A great deal of research is still being carried out on the subject, but the following information is given for general guidance.

Aquaplaning varies considerably with the depth of water on the surface and the type of tire in use, but as the speed of the aircraft and the water depths increase, the water layer builds up, so increasing resistance to displacement resulting in the formation of a wedge of water beneath the tire. This resistance progressively lifts the tire, thereby decreasing the area in contact with the runway until it is possible under certain conditions to lift the tire completely clear of the surface. If the full aquaplaning condition, the tire is no longer capable of providing directional control or effective braking, and in this condition the drag forces are very low and are equivalent to a braking coefficient of only about 0.05 compared with a representative figure of 0.15 for a normal typical wet surface at high speeds.

Research so far indicates that with typical aircraft tires and runway surface textures, aquaplaning is unlikely to be initiated in water depth of less than 5 mm. although under some conditions the minimum depth may be as low as 2½ mm. However, once aquaplaning has commenced, it may be sustained over areas of runway where water depth is lower than that required to initiate aquaplaning. It should be noted that on a normal runway water will usually drain at the rate of 2½ mm/minute.

A simple formula has been devised to obtain the minimum initiating aquaplaning speed in knots and is $9 \times \sqrt{\text{tire pressure (lbs./sq.in.)}}$ which in the case of the CL-44 is $9.0\sqrt{165} = 115$ knots, for the main wheels.

Ribbed tires tend to offset the advent of aquaplaning and the efficiency of the tire under these circumstances is dependent upon the depth of the tread, and it should be remembered that the efficiency of the tire is very much impaired when the depth of tread is less than 3 mm.

Avoidance of Aquaplaning in the CL-44 Aircraft

When the captain of an aircraft is advised prior to landing that the runway is very wet, especially if there are pools of water on that part likely to be used in the landing run, he should consider holding until the water has drained away, and, if conditions do not improve, serious consideration should be given to diverting to another airfield, particularly if the runway is marginal in length or is known to have a smooth surface. When a captain decides to land on a runway that still has a certain amount of water, and he considers that aquaplaning is possible, he should land the aircraft sufficiently firmly to break through the surface of water and should not attempt a really smooth landing, as this will only tend to initiate aquaplaning.

NORMAL FLIGHT HANDLING PROCEDURES

Stalling

In the flap up configuration only, with power on or off, there is a noticeable stall warning by natural buffet. In all other configuration this natural buffet exists, but is either too weak or too close to the stall to provide adequate warning. The stall warning unit provides this indication artificially by imparting a vibration to the control column at speeds approximately 10% above the stalling speed under all conditions and configurations.

In all configurations the arrival of the stall is heralded by a buffet, followed by a pitch down with the starboard wing usually dropping. The pitch down varies in strength with configuration, power and C of G. With a forward C of G condition and reduction in power, there is less elevator force available to stall the aircraft and, at extreme combinations of these factors, the aircraft can achieve a minimum steady flight speed with full up elevator.

Stall recovery technique is quite normal, opposite rudder and aileron being applied against the dropping wing, while the control column is eased forward and power applied. If the control column is held back through the stall, a sharp wing drop and related yaw results. It will be necessary to apply and hold full opposite rudder and aileron while the control column is eased forward, and until control is gained.

NOTE: During recovery from a stall in the gear and flaps down configuration, care must be taken to avoid exceeding the configuration airspeed.

NORMAL SYSTEMS HANDLING PROCEDURES

Weather Radar

The recommended tuning procedure is as follows:

1. Gain and brilliance controls to minimum and range selector to 150 mile scale.
2. Switch to STANDBY on before-taxi check.
3. Tilt scanner upwards to ensure loss of ground return, approximately 10°.
4. Adjust intensity control so that trace is just visible. Increase gain until light snow appears on screen. Adjust tilt as necessary. The gain having been set, no change should be necessary when changing range or going to contour. However, adjustment of the brilliance control might be necessary on changing range.

NORMAL SYSTEMS HANDLING PROCEDURES

AIR CONDITIONING AND PRESSURIZING SYSTEM OPERATION

Because the air conditioning and pressurizing systems are closely related, the handling instructions for these systems are combined.

Ground Air Conditioning with External Ground Conditioning Unit

If the aircraft is being air conditioned by an external ground air conditioning unit, setting of the aircraft air conditioning controls is unnecessary. To avoid possible pressurization, a door or window should be left slightly open.

Ground Air Conditioning with Inboard Engines Running

To operate the air conditioning systems with the aircraft on the ground and the inboard engines running, set the controls as follows:

Temperature selectors	As desired
Valve isolating switches (5)	Normal
Flight deck and cabin temperature control switches	AUTO
Constant-frequency load buses and DC buses	POWER ON
Pneumatic pressure switch	STANDBY 1
Supercharger switches	NORMAL

Air Conditioning and Pressurizing for Flight

Since the aircraft will normally be air conditioned and pressurized for each flight, the positions of all applicable controls will be listed in the preflight checks.

The AUTO position of the pneumatic system selector will be used on differentials above 1 psi. Otherwise no action is required other than regular observations of the system indicators together with such alterations of the temperature selectors as may be necessary to maintain the required cabin and flight deck temperatures.

However, if the ice protection master switch is placed to ON, thereby transferring control of the muff spill valves to the wing anti-icing system, maximum cabin heat will be available only when both muff heat valves are closed. Since these valves will not close under automatic temperature control when the temperature selector is placed to WARMER, the following procedure muast be carried out if maximum cabin heat is required.

Cabin temperature switch	Hold to HEAT until RH MUFF-HT and LH MUFF HT lights illuminate.
RH muff heat switch	ISOLATE
LH muff heat switch	ISOLATE

The cabin temperature control system will then continue to function satisfactorily under automatic control. When the ice protection master switch is placed to OFF, the muff heat switches may be returned to NORMAL.

Descent and Approach Check

The descent and approach check is as follows:

Barometric correction knob (controller)	Set to destination airfield barometric setting
Cabin rate control (controller)	As desired to effect complete depressurization prior to landing.
Cabin altitude selector	Destination airfield altitude
Pneumatic selector	STANDBY 1 at/or below 1 psi differential.

Unpressurized Flight

If it is desired that the aircraft be flown unpressurized, the manual controller should be adjusted to DECREASE.

AUTO PILOT OPERATION

The auto pilot system provides automatic control to maintain the aircraft at the required attitude, altitude and heading. When coupled with the ILS, the auto pilot provides for automatic turn control and automatic ILS approaches. The system requires a warm-up period of 90 seconds, after which the auto pilot is on standby and ready for engagement.

Engaging the Auto Pilot

To engage the auto pilot, proceed as follows:

Auto pilot disconnect lever	IN
Turn controller	Center detent

Trim the aircraft manually to the desired attitude using the three-axis trim indicator as a reference.

NOTES:

1. The ENGAGE switch must be ON for operating the auto pilot in any mode.
2. The artificial feel system must be operative when using the auto pilot.
3. Automatic flight control will be attained only if the angle of bank is less than +30° and/or the pitch angle is less than ±15° from the horizontal at the instant of engagement.
4. The various function selector switches, except the ENGAGE switch, will automatically disengage when an alternate function has been selected or malfunction occurs.

Disengaging the Auto Pilot

To disengage the auto pilot, proceed as follows:

ENGAGE switch or	OFF
AUTO PILOT DISCONNECT button or	PUSH
AUTO PILOT DISCONNECT lever	OUT

NOTE: The AUTO PILOT FAIL warning on the annunciator panels will indicate when the auto pilot is disengaged by any means other than the pilot or first officers auto pilot disconnect button.

Changing Heading

1. Manually controlled turns:

Turn controller	Rotate in desired direction. When required heading is reached, return to the center detent.

NOTE: The rate of application of the turn controller from the center detent to maximum position should not be faster than 7 seconds.

2. Automatically controlled turns:

Course indicator	Set required heading with heading knob.
Turn controller	Check in center detent.
SET HEADING switch	ON

NOTES: 1. An automatically controlled turn can be interrupted by lifting the turn controller in the center detent.

2. For en route flying, it is preferable to use the engage mode rather than the SET HEADING mode, since the engage mode provides a more accurate long-term heading reference.

Maintaining Altitude

When the aircraft is at the desired reference altitude and providing the attitude is within 10° of level flight, proceed as follows:

ALTITUDE switch	ON

CAUTION

DO NOT CHANGE THE SETTING OF THE PILOT-STATIC SELECTOR VALVE WHILE THE ALTITUDE SWITCH IS ON, AS A RAPID CHANGE IN ALTITUDE MAY RESULT.

Automatic ILS Approach

Automatic ILS approach should not be initiated with one or more engines inoperative. In the event of loss of one engine during automatic ILS approach, the auto pilot should be disengaged. Proceed as follows:

VOR 1 receiver	Turn to appropriate frequency.
Course indicator	Using course knob, set course arrow to the required runway heading.

NOTE: Each VOR receiver has its own corresponding glideslope receiver. VOR 1 is normally connected to the pilot's instrument only. VOR 2 may also be tuned to the ILS frequency so that, should the VOR 1 set fail, the presentation of VOR 2 may be channeled to the pilot's instrument and be automatically coupled to the auto pilot by selecting the overhead VHF control to EMERG.

Fly the ILS pattern, using ALTITUDE and SET HEADING mode as required. When flying the last stage of the procedure, turn so as to intercept the inbound localizer at an angle approximating 45°. When the localizer beam is intercepted, proceed as follows:

LOCALIZER switch	ON

NOTE: The maximum localizer capture angle of the auto pilot is 90° at a minimum distance of 18 miles.

Monitor the glideslope presentation, and when the aircraft intercepts the center of the glidepath, proceed as follows:

GLIDESLOPE switch ON

Optimum altitude for engaging the glideslope is 1500 feet above destination altitude.

Disengage the auto pilot for final approach to landing.

ELECTRICAL SYSTEM OPERATION

Before Flight

The electrical system ground check, carried out after starting the first engine is as follows:

1. Constant-frequency AC system

   a. When No. 1 engine has attained ground idling speed, check No. 1 generator for 115 (±3 volts) and 400 (±4) cycles, switch constant-frequency AC GPU switch to OFF, check GPU BRK CLOSED light and No. 1 BRK OPEN light go out.

   b. Check two green ALTERNATE BUS TIE CLOSED lights on.

   c. Place bus isolating switch to BUS A ISOLATE and check that associated alternate bus tie light goes out. Return switch to NORMAL and check that light comes on again.

   d. Repeat c. with isolating switch to BUS B ISOLATED.

   NOTE: This is to be accomplished prior to engine further starts in order to avoid loss of T.F.T. indication during the starting process.

   e. When No. 2 engine attains ground idling speed, check No. 2 BRK OPEN light and associated bus tie light out.

   f. Check No. 2 generator for 115 (±3) volts and 400 (±4) cycles.

   g. Repeat e. and f. for engine No. 4.

   h. Check that each generator watt-varmeter is reading.

2. DC system

   With all engines started and ground power removed, conduct the following check:

   Ensure that all TRU's and batteries are switched on, then:

   a. Switch off battery, No. 2 and No. 3 TRU. Check load and voltage No. 1 TRU (26.5 - 30.5 volts).

   b. Switch on No. 3 TRU, switch off No. 1 TRU. Check load and voltage No. 3 TRU (26.5 - 30.5 volts).

c. Switch on No. 2 TRU, switch off No. 3 TRU. Check load and voltage No. 2 TRU (26.5 - 30.5 volts).

d. Switch on battery, switch off No. 2 TRU, check battery voltage (minimum acceptable 22 volts at 60°F.).

e. Leave battery on. Switch all TRUs on. Check loads and voltage.

f. Check no input lights are off.

The variable-frequency generators must not be switched onto line until L.P.R.P.M. is 67% or more. When the engines have attained correct speed, check as follows:

a. Place No. 3 generator control switch to RESET then NORMAL and check that No. 3 BRK OPEN light goes out and ALTERNATE BUS TIE CLOSED lights stay on.

b. Check No. 3 generator for 115 (±4) volts.

c. Place bus isolating switch to BUS A ISOLATE and check associated ALTERNATE BUS TIE CLOSED light goes out. Return switch to NORMAL and check light comes on again.

d. Repeat c. with isolating switch to BUS B ISOLATE.

e. Place No. 1 generator control switch to RESET then NORMAL and check that No. 1 BRK OPEN light and associated ALTERNATE BUS TIE CLOSED lights go out.

f. Check No. 1 generator for 115 (±4) volts.

g. Repeat e. and f. for engine No. 4.

h. Check that each generator watt-varmeter is reading.

During Flight

Regular observation must be made of the electrical control panels to verify satisfactory operation.

Shutdown

Before engine speed is reduced below 67% L.P.R.P.M. on engine shutdown, the variable-frequency AC system must be tripped off line by placing each variable-frequency generator control switch to TRIP and checking that the BRK OPEN lights come on.

All unnecessary electrical loads must be switched off before shutting down the engines. No. 1 generator must be tripped off line prior to No. 1 engine being shut down. Disconnection of the power sources from the buses is automatic except for battery power to the essential bus. The disconnecting of the battery is covered in the normal shut down procedure.

FIRE DETECTION SYSTEM TEST OPERATION

Master Warning System

Master warning system	TEST/NORMAL switch	TEST

Check:

a. All annunciator panel lights illuminate
b. All red master warning and amber master caution lights at pilots and systems operators stations flash.
c. Horizontal stabilizer fire control warning light, cabin differential pressure exceeded warning light, engine fuel low pressure lights at systems operators station illuminate, together with condition lever warning lights and engine fire warning lights.
d. Warning bell rings.

Horizontal Stabilizer Fire Control

ARMED/NORMAL/TEST switch	TEST

Check:

a. HORIZ STAB light on systems operators panel illuminates.
b. All red master warning lights at pilots and systems operators stations flash.
c. Annunciator panel STAB HTR FIRE light illuminates.
d. Warning bell rings.

Engine Fire Control

Engine fire and tailpipe overheat TEST/NORMAL switch	TEST

Check:

a. All red master warning lights at pilots and systems operators stations flash.
b. Condition lever lights illuminate.
c. Annunciator panel TAILPIPE/O/HEAT light illuminates.
d. Engine fire detector lights illuminate.
e. Warning bell rings.

Cabin Smoke Control

PUSH TO DETECT button - Depress and check smoke indicator ON light illuminates.

NORMAL SYSTEMS HANDLING PROCEDURES

PNEUMATIC SYSTEM

The aircraft is fitted with three pneumatic systems. Two are driven electrically and one system is tapped from the inboard engines, controlled by single switch marked OFF, STANDBY 1, STANDBY 2, and AUTO. The STANDBY 1 & 2 selections operate the electrically driven pumps. The AUTO selection connects the engine system. The pneumatic system should be on STANDBY 1 or 2 for all take-offs and landings, with AUTO selection for normal flight. The pneumatic system pressures the hydraulic reservoir and swing tail seal. It also provides operating pressure for the air conditioning control units. In addition, the electric pumps operate a jet pump to provide a reference pressure for the outflow valves of the pressurization system for take-off and landings.

HYDRAULIC SYSTEM

There are four power sources for the hydraulic system - two engine driven pumps, one electrically driven pump and a hand pump. The main system pressure is controlled by a LOAD/UNLOAD switch at the Flight Engineer station. The system should be loaded only when a demand of main hydraulic system pressure is required. The system should be unloaded as soon as practical after system demand to prevent overheating of the system.

The electric pump is controlled by the freight door power switch and pressurizes the main system for swing tail and freight door operation.

The hand pump is controlled by an electrical switch marked LANDING/GEAR or emergency brake and a manual selector switch for main system or emergency use as dictated by the position of the electrical switch. The hand pump and electrical pump are both connected to the hydraulic reservoir reserve supply; therefore, the electric pump should not be used to assist the engine driven pumps to pressurize the main system during flight.

ANTI-ICING SYSTEMS OPERATION

Before Flight

Windshield and pitot heat must be switched on prior to, and remain on during, all flights as called on check list.

During Flight

The ice detection green ON light at the systems operators panel will be illuminated during flight, denoting that the ice detector system is armed. When icing conditions are encountered, the ice detection system will provide a warning through the master warning system and cycle the red ICE light.

The ice protection master switch should then be switched ON to start operation of the anti-icing systems, and a check made that all switches on the anti-icing panels are in the NORMAL position.

NOTE: If rapid ice build-up is encountered before the anti-icing is switched on, consideration should be given to using the "late selection" drill for the engine anti-icing system.

The de-icing cyclic timer switch must be placed to FAST for ambient temperatures above -8°C. and SLOW for ambient temperatures below -8°C. No further action on the part of the crew is necessary other than monitoring the anti-icing system indicators. The ice protection master switch may be switched to OFF when no longer required.

The wing anti-icing system is not to be selected ON at take-off or climb R.P.M. if the aircraft speed is below 150 knots.

After Landing

After landing, windshield and pitot heat must be switched off.

Engines and Propellers

For maximum protection against ice, the engine and propeller de-icing system should be activated at all times when OAT is below +10°C, except when it is certain that icing will not be encountered.

Propellers and cowls de-iging switch..........NORMAL

Engine guide vane anti-icing switch...........OFF

Ice protection master switch..................ON

De-icing timer switches (3)...................FAST (above -8°C.)
SLOW (below -8°C.)
MAIN
NORMAL

The engine guide vane anti-icing switch need only be switched to NORMAL when an ice warning is received. Engine guide vane anti-icing is not to be used during take-off or landing or when full power may be required. Check system operation as follows:

Green READY and amber PARTIAL FAILURE lights OUT

Green PROPS/COWLS cycling lights operating correctly

Green nacelle scoops lights cycling ON/OFF

Windshields

The windshields are electrically heated to prevent ice accumulation and to maintain bird-proof strength. High heat selection should only be used when absolutely required to maintain vision. Under conditions of low O.A.T. the

the windows should be warmed slowly. Under high O.A.T. conditions, windshield heat test will not be conclusive. Test position of the windshield heat control must be used with caution as windshield damage can occue.

Windshield Damage

In the event of windshield damage: Refer to Figure 12

Airframe

The wings and horizontal stabilizer are anti-iced by heated air in the leading edges. The elevator horns are protected by electrically operated heating mats. The aircraft has been demonstrated to satisfy applicable airworthiness requirements without ice protection for the vertical stabilizer. On receipt of an ice warning, check that ice protection master switch is ON, that all control switches on systems operators surfaces anti-ice panel are in NORMAL position and monitor indicator lights and temperature indicators for proper operation.

For effective lighting of the horizontal stabilizer anti-icing heater at altitudes between 20,000 and 30,000 feet, observe the following maximum airspeed:

> 185 knots IAS at 30,000 feet altitude increasing by 6 knots IAS for each 1,000 feet below 30,000 feet.

Rudder Control System

The rudder jack box is protected by an electrically operated jacket.

The purpose of the jacket is to preclude the possibility of moisture freezing in the jack box and restricting rudder movement. Two thermal switches are located in the blanket unit. The low switch setting "opens" at 60° ± 5° and "closes" at 40° ± 5°. The high setting switch "opens" at 95° ± 5° and "closes" at 75° ± 5°.

The heater should be switched ON when roughness or seizure of the rudder control is encountered. As a precautionary measure it may also be switched ON when the airplane enters frigid temperatures following prolonged exposure to moisture.

The blanket unit is capable of raising the jack box temperature from -65° to a minimum of +40°F. within 30 minutes after switching the heater ON.

The control switch is located on the flight engineer's anti-icing control panel and operates independently of the IPM switch. There is no cockpit indication when the heater mat is operating other than the ON and OFF positions of the control switch. This switch should always be OFF when the aircraft is on the ground to prevent unnecessary heat being applied to the blanket when the GPU is on the aircraft. Unnecessary heat can also result in rapid drying out of the box lubricant resulting in rough controls.

The electrical power source for the heater unit comes from the constant-frequency bus and the circuit breaker is located on the constant frequency panel A4B2.

Operational Procedures for In-flight Windshield Failures

	Description of Damage	Panel Affected	
		Centre, Main or DV	Rear
1	Arcing or electrical power failure	Switch off electrical power to panel. Restrict airspeed to 200kts below 10,000 feet.	Switch off electrical power to panel.
2	Breakage of outer glass ply	As in 1	No restriction
3	Breakage of centre glass ply	No restriction	No restriction
4	Breakage of inner glass ply	No restriction	Switch off electrical power to panel.
5	Breakage of outer and inner glass plies	Switch off electrical power to panel. Restrict airspeed to 200kts below 10,000 feet.	As in 4
6	Breakage of outer and centre glass plies	As in 5	No restriction
7	Breakage of centre and inner glass plies	Switch off electrical power to panel. Reduce cabin differential to zero. Restrict airspeed to 200kts below 10,000 feet.	Switch off electrical power to panel. Reduce cabin differential to zero.
8	Breakage of all three glass plies	As in 7	As in 7

Figure 12

OXYGEN SYSTEM PRE-FLIGHT CHECK

Prior to each flight the oxygen system and equipment is tested as follows:

Line valve	Open
System pressure gauge	Pressure checked
Continuous flow regulator	OFF
Each crew regulator diluter switch	NORMAL OXYGEN, breath oxygen and check flow on flow indicator. Repeat with switch at 100% oxygen.

FUEL SYSTEM

REFUELING PROCEDURE

The following refueling procedure is to be followed by the Flight Engineer when it is necessary for him to supervise, or do, the actual refueling. Any tanks being refueled above the 80% level will require the precheck procedure.

Preparation

1. Head the aircraft into the wind, if possible.
2. Park the brakes or chock the wheels.
3. Ground the aircraft from three positions.
    a. Two inboard nacelles
    b. Rear fuselage station 1070
4. Refueling truck to the right and forward of No. 4 nacelle so that fuel quantity meter is in sight of man at ground control panel.
5. Fire equipment in the area of the refueling truck and the refueling point of the aircraft.

NORMAL SYSTEMS HANDLING PROCEDURES

CONTAMINATION/WATER CHECK

A. Items needed:

1. One (1) fuel drain sump plunger
2. One (1) Mason type glass jar (container)

B. Procedure (Initial Check)

1. Best results can be obtained by waiting 1 to 3 hours after fueling A/C prior to draining low point sumps. DO NOT OPERATE BOOST PUMPS PRIOR TO CHECK. This could result in an unsatisfactory check due to any disturbance of sediment or water at the low point sumps.
2. Connect Mason jar (container) to the fuel drain sump plunger. Insert plunger to the low point sump drain and withdraw fuel into the container for a visual check. Remove plunger and container. Visually inspect fuel for proper color, any moisture/water content and for any type of sediment/contamination matter.
3. Continue with Procedure B.2. for any tank/manifold low point sump drain which will be of required use.

C. Procedure (En Route Check)

If Procedure B. checked satisfactorily, an additional check of fuel contamination for any en route fuel stops would proceed as follows:

A. Obtain Mason jar (container) and request a fuel sample from the low point drain sump for the final point of exit from which the new fuel supply is being obtained.

B. Observe fuel for contamination as in Procedure B.2.

Refueling - with Precheck

1. Determine the fuel load and distribution. (See Figure 13.)
2. Place the four fuel selector switches FE station to the OFF position.
3. Select "ground" on the manifold shut-off valve switches (FE station) of the tanks to be refueled.
4. Connect fueling hose and start pump. Do not exceed 50 psi.
5. At ground control panel, open No. 1 manifold shut-off valve and note rate at which fuel enters tank.
6. Select No. 1 tank on rotary selector switch, press and hold modulator test switch. Fuel flow should decrease.
7. Press and hold shut-off test switch. Fuel flow should cease. Close No. 1 manifold shut-off valve.
8. Repeat this procedure for other tanks being refueled above the 80% level. When checking a tank, the manifold shut-off valves for all other tanks must be closed.
9. When checking tanks No. 5 and No. 7 per Para. 6, the modulated flow must not exceed 9 U.S. gals./min.
10. For those aircraft fitted with auxiliary tank excess pressure blow off valves, check valves for freedom of operation.
11. After prechecking the tanks, open the manifold shut-off valves for the tanks being refueled and commence fueling.
12. As each tank reaches its correct quantity, close that particular manifold shut-off valve. Monitor fuel quantity with the drip-sticks.
13. After all tanks are fueled to their proper quantity, ensure that all manifold shut-off valve switches at ground control panel are off. Secure adapter cap.

WARNING

If there is no indication from either of the pilot valves within two minutes, close the manifold shut-off valve to the affected tank. This tank should not be refueled through the single point adaptor until the malfunction is cleared.

Fill that tank via the over-the-wing method.

Fuel Loading Schedule - JP-1 and JP-4 Fuel

<table>
<tr><td colspan="2">JP-1 FUEL at 8.2 pounds per Imperial (6.8 pounds per US) gallon</td></tr>
<tr><td>TOTAL FUEL TO BE CARRIED</td><td>LOAD FUEL AS FOLLOWS</td></tr>
<tr><td>Zero to 3660 Imperial (4395 US) gallons (30,000 pounds)</td><td>Load fuel evenly in four main tanks</td></tr>
<tr><td>3660 Imperial (4395 US) gallons (30,000 pounds)
to
8470 Imperial (10,170 US) gallons (69,470 pounds)</td><td>(a) Fill outboard auxiliaries to capacity
(b) Load remainder evenly into four main tanks</td></tr>
<tr><td>8470 Imperial (10,170 US) gallons (69,470 pounds)
to
Full capacity</td><td>(a) Fill outboard auxiliaries to capacity
(b) Fill four main tanks to capacity
(c) Load remainder into centre auxiliary</td></tr>
<tr><td colspan="2">JP-4 FUEL at 7.8 pounds per Imperial (6.5 pounds per US) gallon</td></tr>
<tr><td>Zero to 3850 Imperial (4625 US) gallons (30,000 pounds)</td><td>Load fuel evenly in four main tanks</td></tr>
<tr><td>3850 Imperial (4625 US) gallons (30,000 pounds)
to
8470 Imperial (10,170 US) gallons (66,000 pounds)</td><td>(a) Fill outboard auxiliaries to capacity
(b) Load remainder evenly in four main tanks</td></tr>
<tr><td>8470 Imperial (10,170 US) gallons (66,000 pounds)
to
Full capacity</td><td>(a) Fill outboard auxiliaries to capacity
(b) Fill four main tanks to capacity
(c) Load remainder in centre auxiliary</td></tr>
</table>

Figure 13

Refueling - without Precheck

1. Determine the fuel load and distribution (See Figure 13).
2. Place the four fuel selector switches (FE station) to the OFF position.
3. Select GROUND on the manifold shut-off valve switches (FE station) of the tanks to be refueled.
4. Connect fueling hose and start pump. Do not exceed 50 psi.
5. At the ground control panel, open manifold shut-off valves of tanks to be refueled.
6. As each tank reaches its correct quantity, close that particular manifold shut-off valve. Monitor fuel quantity with the drip-sticks.
7. After all tanks are fueled to their proper quantity, ensure that all manifold shut-off valve switches at ground control panel are OFF. Secure adaptor cap.

Fuel Management

A. Fuel Consumption Schedules

For table of fuel consumption schedules, refer to Figures 14 and 14A.

B. Normal Operation

Normal operation of the fuel system for starting, take-off, climbing, cruising and landing is as follows: (Ref. Figure 15)

Fuel selector switches	TANK-ENGINE
Main tanks booster pump switches	ON
Manifold shut-off switches	CLOSE
Dump switches	CLOSE (guarded)
Auxiliary tanks booster pump switches	OFF

NOTES: 1. Fuel loading and consumption must be in accordance with the schedule as outlined in Figures 13, 14, and 14A, except when operating under the alternate procedure of NOTES 5. and 6. following.

2. Contents of the center auxiliary tank must be transferred to the main tanks when the available capacity in the four main tanks permits total transfer of the fuel from the center auxiliary tank except when operating under the alternate procedure of NOTES 5. & 6. following.

3. Contents of the outboard auxiliary tanks must not be transferred to the main tanks until the total fuel weight is less than 30,000 pounds.

4. The aircraft should not be landed with fuel in the outboard auxiliary tanks.

5. Irrespective of the fuel loading and consumption schedules of Figures 13, 14, and 14A, the aircraft may be operated with any preselected quantity of fuel in the center auxiliary tank provided the selected quantity is considered to be cargo and is included in the zero-fuel weight of the aircraft. Center auxiliary tank fuel in excess of the preselected cargo quantity must be loaded and consumed in accordance with the schedules of Figures 13, 14, and 14A. Placard cargo loads of the fuselage are not affected by cargo fuel.

6. In the event of a booster pump failure in any one of the four main tanks, take-off and landing may be conducted using fuel supplied from No. 6 tank to the appropriate engine, in accordance with the following procedure:

All manifold shut-off switches	CLOSE
No. 6 fuel booster pump switch	ON
Appropriate fuel selector switch	MANIFOLD-ENGINE

C. Fuel Transfer

Fuel transfer from the auxiliary tanks is performed as follows: (Ref. Figure 16.)

Auxiliary tank booster pump switch	ON
1, 2, 3 & 4 manifold shut-off valve switches	OPEN
When fuel indicator shows empty or the low pressure warning light illuminates, place auxiliary tank booster pump switch.	OFF
All manifold shut-off valve switches	CLOSE

D. Fuel Cross-Transfer

Fuel cross-transfer from the main tanks is performed as follows: (Ref. Figure 17)

Fuel selector switch(es) for tanks from which fuel is being transferred	TANK-ENGINE MANIFOLD

Appropriate tank manifold shut-off valve switches	OPEN
When required amount of fuel has been transferred, place manifold shut-off valve switches	CLOSE
Fuel selector switches	TANK-ENGINE

E. Fuel Cross-feeding

Fuel cross-feeding is performed as follows: (Ref. Figure 18)

All manifold shut-off valve switches	CLOSE
Fuel selector switches	TANK-ENGINE-MANIFOLD
Booster pump switches	Operate as required to maintain fuel balance

FLIGHT FINE PITCH STOPS - PROPELLER

When in position on the runway, before initiating the take-off roll Pilot will check the FLIGHT FINE PITCH STOPS.

NOTE: The Flight Fine Pitch Stops check may be accomplished just prior to taxiing into position on the runway provided there are no small planes or other objects immediately behind the aircraft that might be damaged by the propeller airblast.

1. Advise Flight Engineer "Checking Flight Fine Pitch Stops."
2. Ensure variable frequency generators tripped.
3. Advance power levers into the flight range, check Beta warning lights out and increase power until at least 70% L.P.R.P.M. is indicated.
4. Return power lever to FLIGHT IDLE and note L.P.R.P.M. drop to approximately 56-65%, check fuel flow is approximately 580 lbs./hr. and torque not below 35 psi.

The purpose of this check is to determine if the Flight Fine Pitch Stop has engaged. It if has, the R.P.M. will decrease below minimum constant speed because the propeller is limited to +12° pitch and the fuel control is limited to flight idle fuel resulting in a drop of L.P.R.P.M.

NOTE: If a fluctuating oil pressure is observed, proceed as follows: (Not required when S.I.C. 421 incorporated.)

Pull the Coarse Pitch Solenoid circuit breaker on the affected engine (D.C. Main Circuit Breaker Panel). If the oil pressure stabilizes, and

Fuel Consumption Schedule - JP-1 Fuel

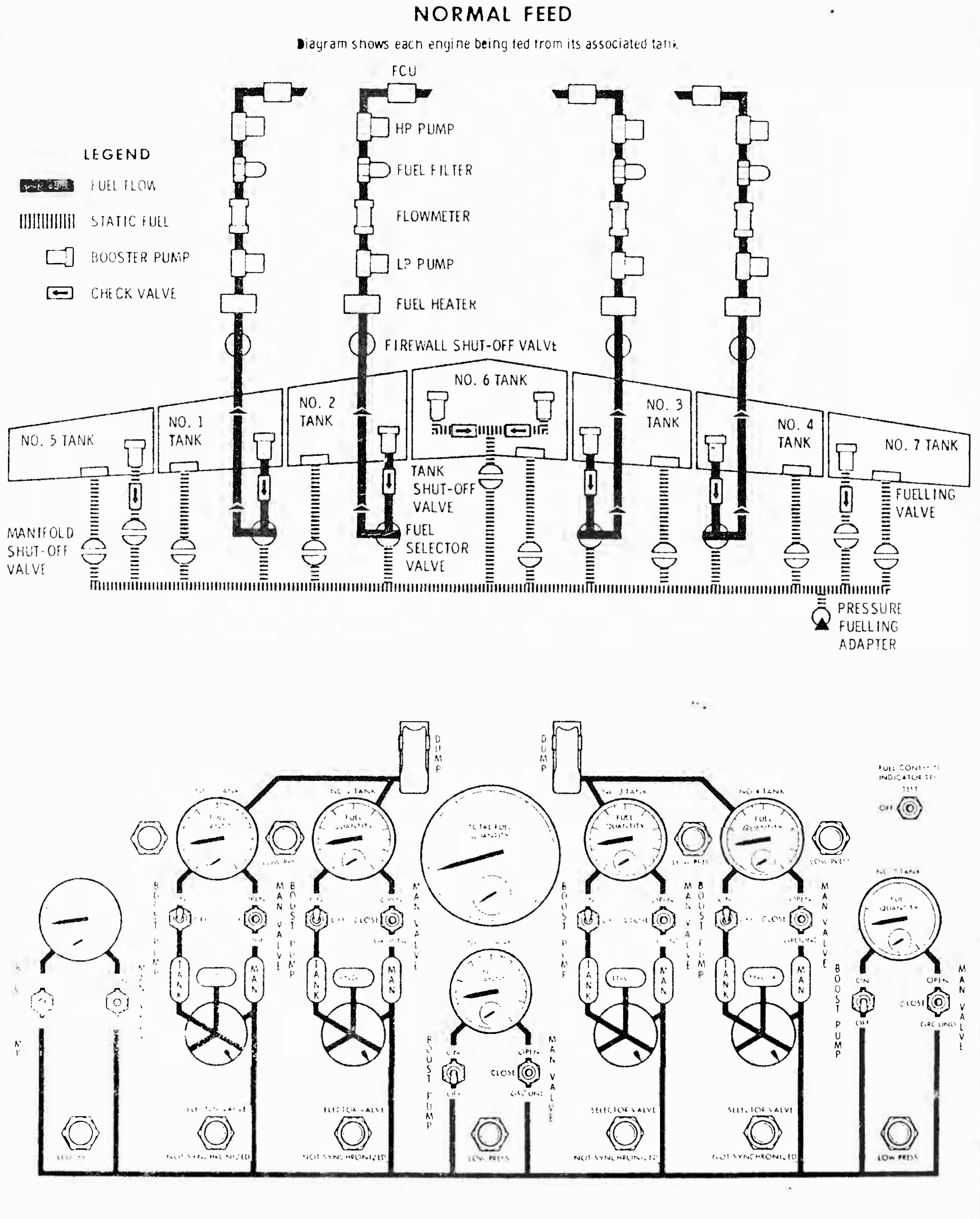
JP-1 FUEL at 8.2 pounds per Imperial (6.8 pounds per US) gallon	
TOTAL FUEL AT TAKE-OFF	CONSUME FUEL AS FOLLOWS
Zero to 3660 Imperial (4395 US) gallons (30,000 pounds)	Use fuel evenly from the four main tanks
3660 Imperial (4395 US) gallons (30,000 pounds) to 8470 Imperial (10,170 US) gallons (69,470 pounds)	(a) Use fuel evenly from four main tanks (b) When fuel remaining in each main tank is 690 Imperial (830 US) gallons (5645 pounds), transfer all fuel from outboard auxiliaries to mains in such a manner as to distribute fuel evenly in the four mains (c) Use fuel evenly from four main tanks
8470 Imperial (10,170 US) gallons (69,470 pounds) to Full capacity	(a) Use fuel evenly from four main tanks (b) When fuel remaining in each main tank is 1475 Imperial (1770 US) gallons (12,035 pounds), transfer all fuel from centre auxiliary to mains in such a manner as to distribute fuel evenly in the four mains (c) Use fuel evenly from four main tanks (d) When fuel remaining in each main tank is 690 Imperial (830 US) gallons (5645 pounds), transfer all fuel from outboard auxiliaries to mains in such a manner as to distribute fuel evenly in the four mains (e) Use fuel evenly from four main tanks

Figure 14

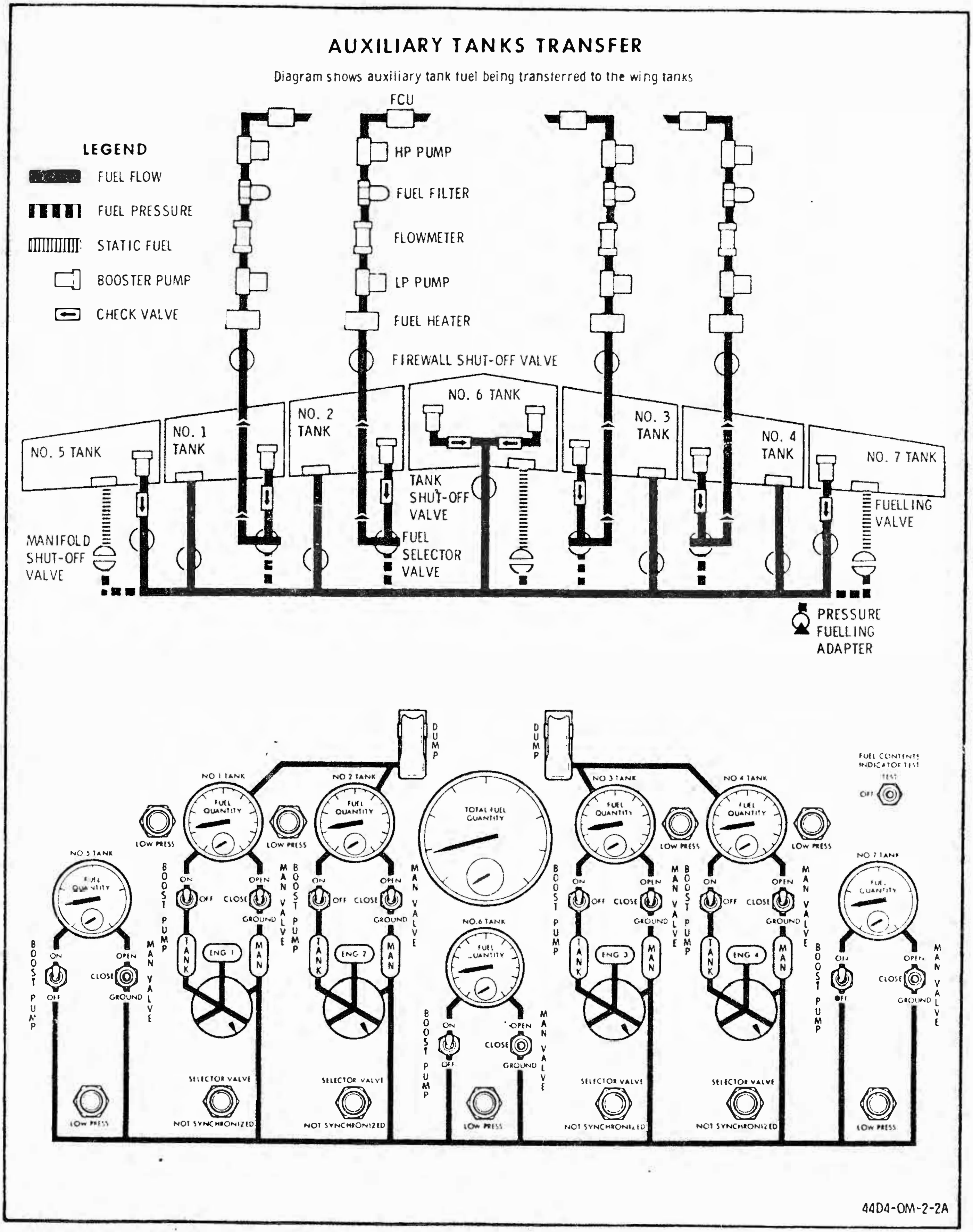
Fuel Consumption Schedule - JP-4 Fuel

JP-4 FUEL at 7.8 pounds per Imperial (6.5 pounds per US) gallon	
TOTAL FUEL AT TAKE-OFF	CONSUME FUEL AS FOLLOWS
Zero to 3850 Imperial (4625 US) gallons (30,000 pounds)	Use fuel evenly from four main tanks
3850 Imperial (4625 US) gallons (30,000 pounds) to 8470 Imperial (10,170 US) gallons (66,000 pounds)	(a) Use fuel evenly from four tanks (b) When fuel remaining in each main tank is 730 Imperial (875 US) gallons (5690 pounds), transfer all fuel from outboard auxiliaries to mains in such a manner as to distribute fuel evenly in the four mains (c) Use fuel evenly from four main tanks
8470 Imperial (10,170 US) gallons (66,000 pounds) to Full capacity	(a) Use fuel evenly from four main tanks (b) When fuel remaining in each main tank is 1475 Imperial (1770 US) gallons (11,505 pounds), transfer all fuel from centre auxiliary to mains in such a manner as to distribute fuel evenly in the four mains (c) Use fuel evenly from four main tanks (d) When fuel remaining in each main tank is 730 Imperial (875 US) gallons (5690 pounds), transfer all fuel from outboard auxiliaries to mains in such a manner as to distribute fuel evenly in the four mains (e) Use fuel evenly from four main tanks

Figure 14A



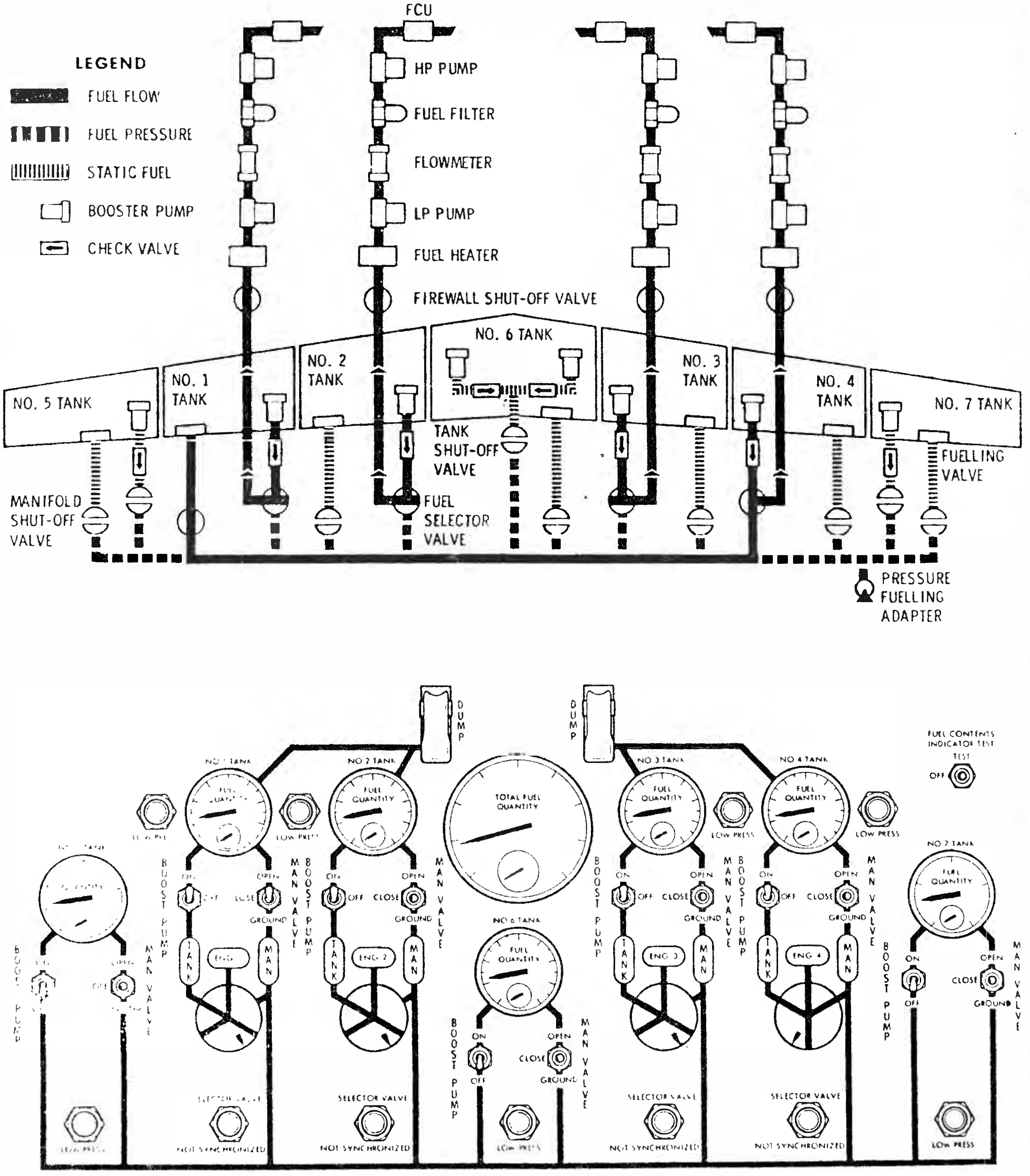
Fuel Management Diagram - Normal Feed
Figure 15



Fuel Management Diagram - Auxiliary Tanks Transfer
Figure 16

CROSS-TRANSFER

Diagram shows fuel being cross-transferred from No. 4 tank to No. 1 tank.



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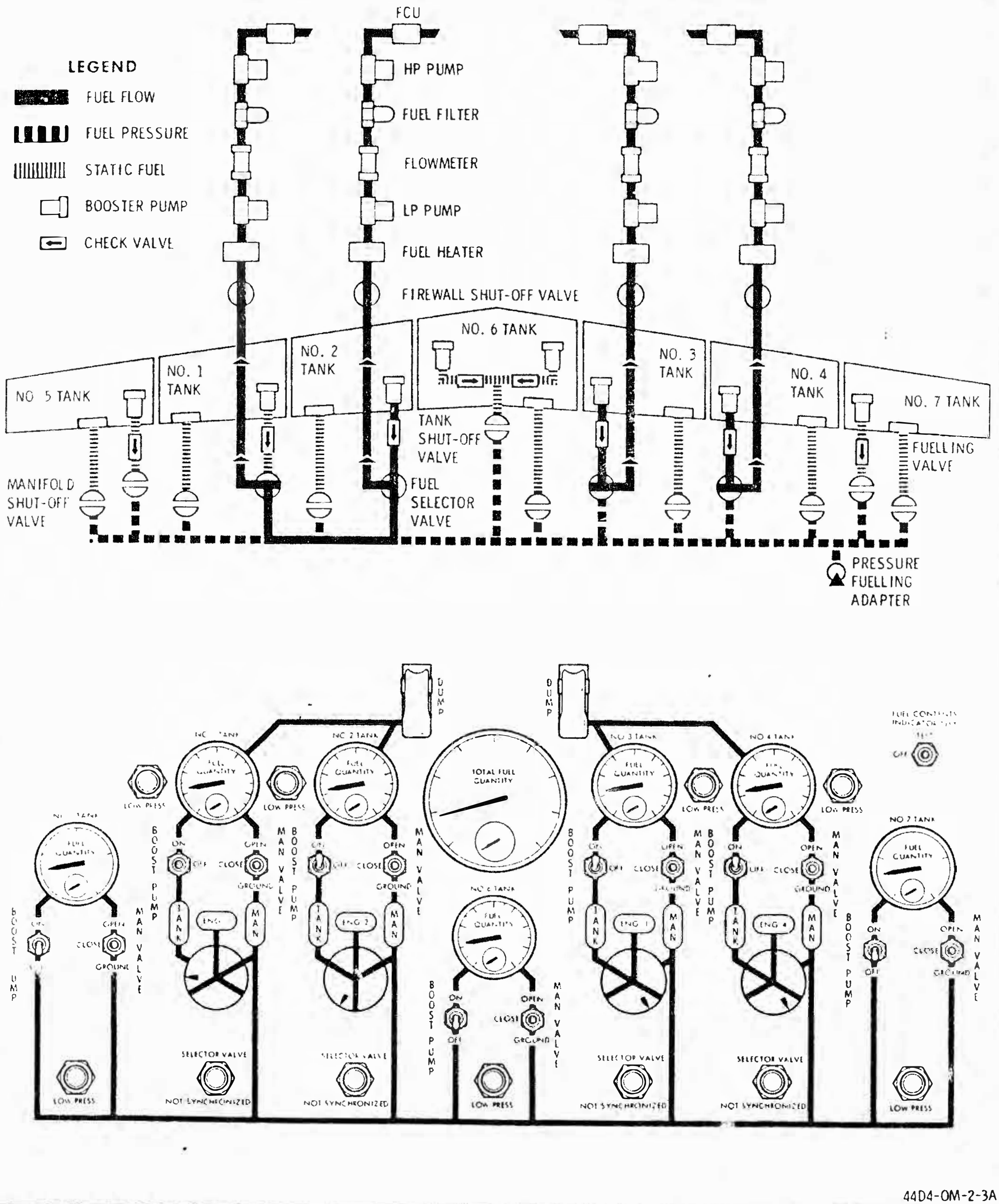
Fuel Management Diagram - Cross-transfer
Figure 17

CROSS-FEED

Diagram shows No. 1 engine being cross-fed from No. 2 tank



Fuel Management Diagram - Cross-feed
Figure 18

no appreciable increase in L.P.R.P.M. is noted, this indicates that the Secondary Flight Fine Pitch Stop is improperly rigged and is controlling the prop prior to the mechanical flight fine pitch stop setting. Repeat the check. If indications are normal, and at the Captain's discretion, the Coarse Pitch Solenoid Circuit breaker may be RESET and the take-off can be made. An entry should be made in the log book and the condition corrected prior to subsequent take-offs.

OPERATION OF THE SWING TAIL AND CARGO DOOR

The swing tail and the cargo door are hydraulically operated and electrically controlled. Hydraulic pressure for both systems is normally provided by the auxiliary hydraulic pump, but the hand pump - No. 1 engine drive pump - or an external source can be used. To operate the swing tail or cargo door using the auxiliary hydraulic pump, proceed as follows:

Swing Tail - Opening

1. Check for obstructions.
2. Place pneumatic pump switch to STANDBY No. 1.
3. Place system load/unload switch to LOAD.
4. Proceed to swing tail control panel.
5. Remove the hydraulic pressure line from the stowage fitting and connect it to the swing tail pressure fitting.
6. Place the hydraulic pump switch ON.
7. Select OPEN on the swing tail control switch until the tail is fully open and the light marked OPEN & LOCKED illuminates.
8. Switch off hydraulic pump.
9. Retract fuselage aligning ramp to provide free access for cargo handling.

Swing Tail - Closing

1. Check for obstructions.
2. Pneumatic system to STANDBY No. 1
3. System load/unload switch to LOAD.
4. Return fuselage aligning ramp to NORMAL position.
5. Auxiliary hydraulic pump ON.
6. Select CLOSE on control switch until the tail is fully closed.

7. Auxiliary hydraulic pump switch to OFF.

8. Disconnect pressure line and stow.

9. Check lights on control panel are out and visually inspect the latch pins to ensure they are positively engaged.

10. Pneumatic pump OFF.

Cargo Door - Opening

1. Close and lock the forward entrance door.

2. Unlock the cargo door, releasing the shear pins before the hooks.

3. Remove the actuator from the stowed position and connect it to the operating linkage.

4. Ensure that the forward bulkhead door is fully open.

5. Place pneumatic pump switch STANDBY No. 1.

6. Freight door power switch ON.

7. Hold the control switch, on the control panel above the door, to the OPEN position until the door is fully open.

8. Freight door power switch OFF.

9. Place the jury strut in position.

Cargo Door - Closing

1. Check that the forward bulkhead door is fully open.

2. Remove the jury strut

3. Freight door power switch ON. Ensure pneumatic pump switch at STANDBY No. 1 position.

4. Hold the control switch to CLOSE position until the door is fully closed.

5. Freight door power switch OFF.

6. Place pneumatic pump switch OFF.

7. Lock the cargo door, engaging the hooks first and then the shear pins. Visually inspect hooks and shear pins for positive engagement.

8. Disconnect the actuator from the linkage and place in the stowed position.

9. Stow the jury strut.

FERRY FLIGHT OPERATIONS

Three Engine Ferry Flight Operation

Ferry flight of CL-44D4 aircraft with one engine inoperative may be authorized in accordance with the general provisions of CAR 1.77 in conjunction with the specific limitations and procedures of the basic Flight Manual.

A. Limitations

1. Propeller configuration: These data are applicable with the propeller of the inoperative engine either feathered or removed.

2. Maximum take-off weight: The maximum take-off weight for each individual ferry flight shall not exceed the minimum weight necessary for the particular flight, and shall not exceed the lesser of the following:

   a. 190,000 pounds.

   b. The maximum weight permitted by climb performance requirements for the airport elevation and the ambient temperature existing at time of take-off, as presented in Figure 19.

   c. The maximum weight permitted by field length requirements for the airport elevation and runway gradient, and the ambient temperature and wind component existing at time of take-off, as presented in Figure 20.

B. Procedures

1. Take-off:

   a. Pre-select three divisions of rudder trim against the operating asymmetric engine.

   b. The pilot should open two symmetrical engines to full power against the brakes.

   c. The co-pilot should hold the control column full forward and select full aileron against the asymmetric live engine.

   d. The pilot should release the brakes and apply power on the asymmetric engine as rapidly as directional control will allow. (Full power on the asymmetric engine should be achieved by approximately 30 knots. Full rudder and some nosewheel steering will be necessary initially.)

   e. When the three engines are at full power the pilot should take over the control column, maintaining forward pressure as necessary for directional control, and returning aileron to neutral prior to reaching V_R.

f. Firmly rotate at the normal V_R speed.

g. Accelerate to the normal V_2 speed by 35 feet, initiating gear retraction after lift-off.

h. Continue take-off in accordance with approved procedure for take-off following engine failure.

2. Other:

a. Conduct climb to altitude, cruise, descent, and landing operations in accordance with normal procedures for one engine inoperative condition.

C. Maximum Take-off Weight Permitted by Climb Requirements

The maximum take-off weight permitted by climb performance requirements for varying airport altitudes and temperatures is shown in Figure 19.

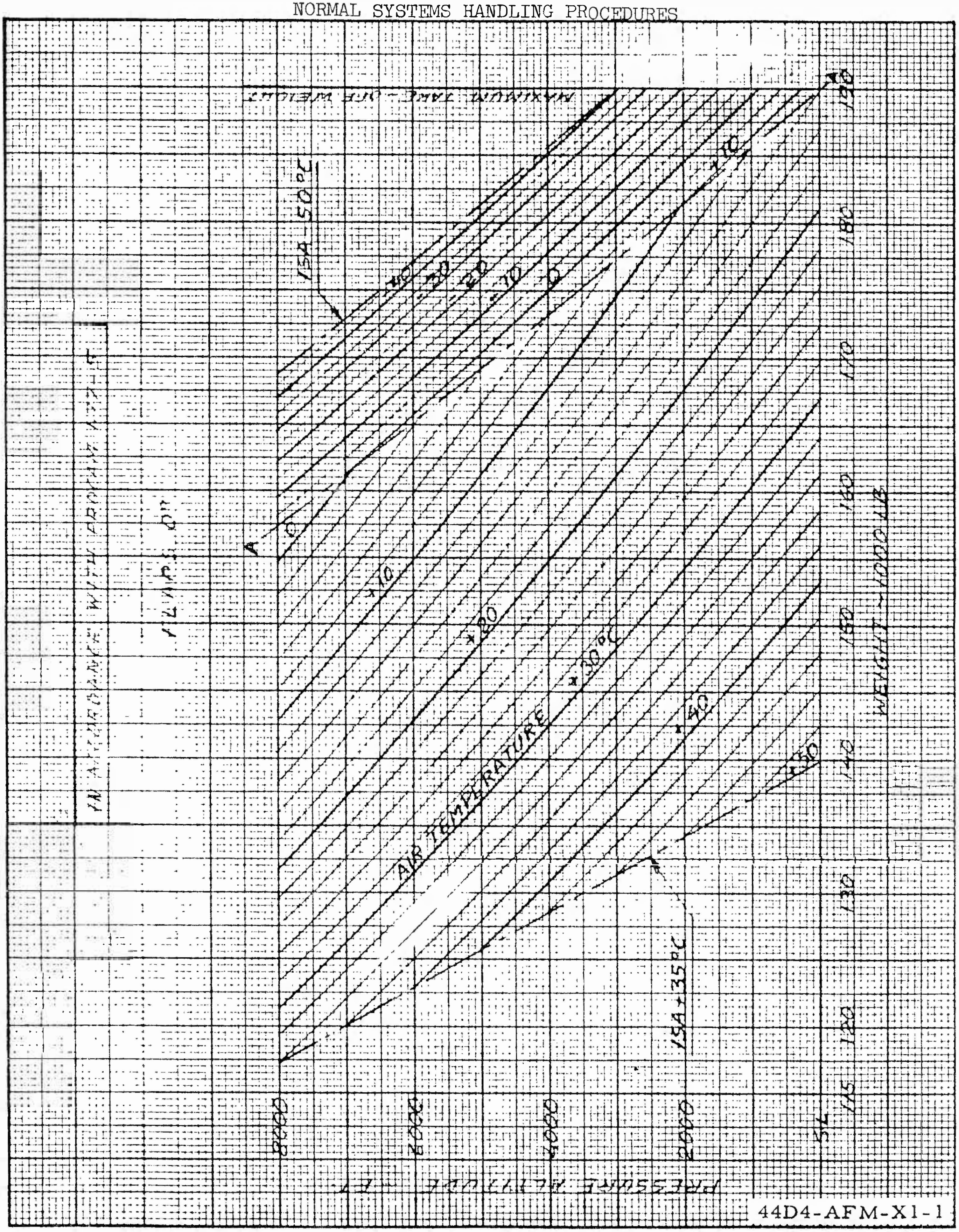
The prescribed condition is the 1.2% climb gradient requirement of PROCAM 1.77-5, at a height 1500 feet above the take-off surface, with two engines inoperative in the Final Take-off Configuration of 4T.120(c).

Aircraft Configuration:

Landing Gear	Retracted
Wing flaps	Retracted
Engines	Two engines inoperative, the propeller feathered on the engine which failed during flight, the propeller of the other inoperative engine removed or feathered. Two engines operating at Maximum Continuous Power.
Airspeed	3-Engine final take-off and minimum flap retraction (Flaps 0°) speed (Section 4, Figure 5)
Pressurization	Ambient altitude

Example: The example shows that at a pressure altitude of 1500 feet and an ambient temperature of 22°C (ISA + 10°C) the maximum permissible take-off weight is 168,000 pounds.

NOTES: 1. The climb requirement on which this chart is based is the only climb requirement specified for 3-engine ferry flight authorization.



Maximum Take-off Weight Permitted by Climb Requirements for Three Engine Ferry Operation
Figure 19

2. At a particular airport the allowable take-off weight may be less than the appropriate maximum permissible take-off weight obtained from this chart because of the field length.

3. The change in slope at line A-A on Figure 19 is caused by the engine operating characteristics.

D. Maximum Take-off Weight Permitted by Take-off Field Length Requirements

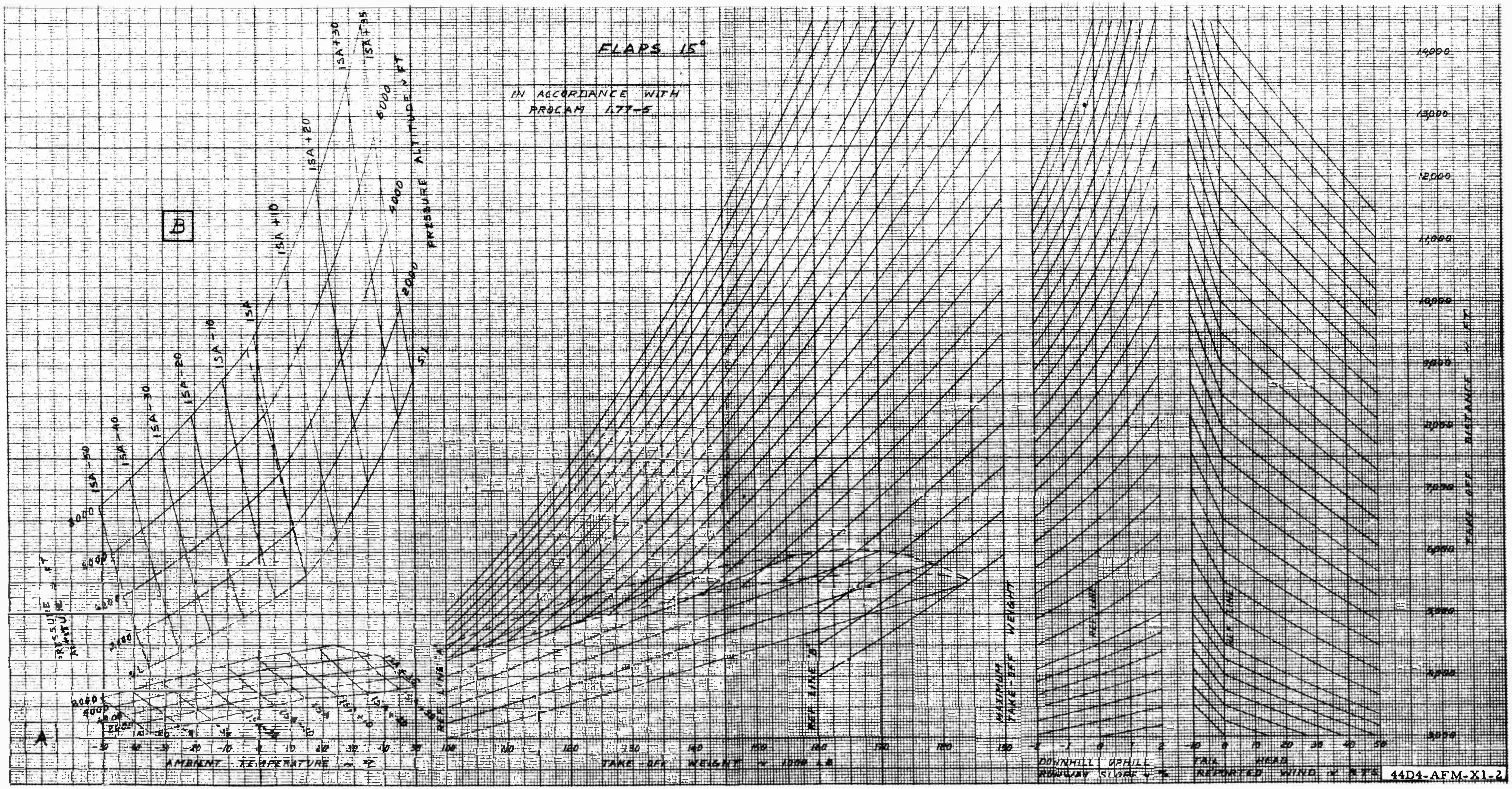
The information given in Figure 20 enables the maximum take-off weight to be determined for a given airport field length at varying ambient temperatures, airport altitudes, runway gradients and reported wind components.

For a given field length, the maximum take-off weight is limited by the three engine take-off distance requirements of PROCAM 1.77-5, i.e. 115 per cent of the take-off distance to 35 feet with one engine inoperative from start of roll.

Associated Conditions:

Landing Gear	Retraction initiated upon lift-off
Wing flaps	15°
Engines	Two symmetrical engines at take-off power from brake release. Power on asymmetric engine applied as directional control permits.
Airspeeds	(See below)
Runway	Hard, dry surface
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

At light weights the engine-out controllability limitation overrides the normal take-off speeds and this has necessitated the separation of the altitude-temperature grid on the left-hand side of Figure 20 into two parts. The upper part B is used for the normal take-off speeds and the lower part A when the engine-out controllability speeds are limiting. To find which part of the grid to use, first determine the take-off weight limited by climb performance from Figure 19. Using this weight and the ambient conditions, determine the Take-off Speed (V_2) from Section 4, Figure 4. Note whether part A or B on this figure is limiting, and use the corresponding grid on Figure 20. An illustrative example for use of this type chart is contained in Section 3, Figure 2. Engine failure recognition speed V_1, and rotation speed, V_R, are as presented in Section 4, Figures 2 and 3, respectively.



Maximum Take-off Weight Permitted by Take-off Field Length Requirements for Three Engine Ferry Operation
Figure 20

FERRY FLIGHT OPERATIONS

Ferry Flight with Landing Gear Doors Removed and with Landing Gear Down

Ferry flight with the landing gear doors removed and with the landing gear in the DOWN or UP position, may be authorized in accordance with the general provisions of FAR 21.197 in conjunction with the following limitation and requirements. Except where altered herein, the normal limitations and procedures of the basic Flight Manual apply.

A. Limitation

Maximum airspeed	240 knots IAS (Landing gear UP or DOWN)

B. Requirements

(1) Landing gear DOWN

- (a) Remove main gear forward doors.
- (b) Remove main gear radius rod doors.
- (c) Remove nose gear aft doors.
- (d) Remove any doors that are damaged.

(2) Landing gear UP

Remove damaged doors.

(3) NOTE: Any door control rods that are left loose as a result of door removal must also be removed.

SECTION 3

OPERATING LIMITATIONS

1. Weight Limitations

A. Maximum Permissible Take-off Weight

Maximum weight approved for take-off varies with airport altitude. ambient temperature, available runway length, runway gradient and wind component existing at the time of take-off. The following limitations apply:

The maximum take-off weight shall not exceed the weight shown in Figure 1 of this Section as appropriate for the airport altitude and the ambient temperature existing at the time of take-off, or the weight shown in Figure 2, as appropriate for the airport altitude, the length and gradient of the runway used for take-off, the ambient temperature and head or tail wind component existing at the time of take-off.

The maximum take-off weight determined from Figures 1 and 2 may be increased by an amount equal to the weight of fuel consumed in taxi, holding and take-off run up to a maximum of 1000 pounds.

The maximum permissible take-off weight shall in no case exceed 210, 000 pounds.

The maximum permissible weight for taxiing shall in no case exceed 211, 000 pounds.

B. Maximum Permissible Landing Weight

Maximum weight approved for landing varies with airport altitude and ambient temperature in accordance with Figure 3. The maximum permissible landing weight shall in no case exceed 165, 000 pounds.

C. Maximum Gross Weight with Zero Fuel

The maximum gross weight with zero fuel shall in no case exceed 155,000 pounds. For variation of limit airspeed, V_{MO}, with zero fuel weight, refer to Para. 5.

D. Fuel Load Limitations

All weights in excess of the maximum gross weight with zero fuel must consist of usable fuel.

All weights in excess of the maximum permissible landing weight must consist of jettisonable fuel.

Irrespective of the gross landing weight, the maximum fuel weight permissible for landing is 30, 000 pounds plus the weight of cargo fuel defined in Note (5) of the Fuel Management Procedure (Ref. Sect. 2, Para. 23.).

Fuel in the main tanks must be distributed symmetrically about the airplane centre-line for landing.

Landing with fuel in the outboard auxiliary tanks is not permissible.

The maximum permissible lateral moment due to asymmetric fuel distribution between left-hand and right-hand tanks is 123, 000 foot-pounds.

E. Approved Loading Schedule

The aircraft must be loaded in accordance with an approved loading schedule based upon authorized weights and associated centre of gravity limits. (Ref. Sect. 20 Weight and Balance.)

In order to prevent damage to the flight control runs under negative G conditions, cargo in the lower compartments must be tied down.

2. Centre of Gravity Limits

The centre of gravity of the aircraft must be maintained within the centre of gravity limits shown in Figure 4.

The datum for the centre of gravity limits is at station zero, which is 633.00 inches forward of a jig point located on the underside of the fuselage. immediately forward of the front spar on the aircraft centre-line. The jig point is a Phillips head screw on the skin joint.

The length of MAC is 192.86 inch.

The leading edge of the MAC is located 665.72 inches aft of Station 0.

3. Operational Limitations

A. Take-off

Altitude	Sea level to 8000 feet
Ambient Temperature	
Maximum	ISA + 35°C
Minimum	ISA - 50°C
Tailwind Component	10 knots
Runway Gradient	± 2%

B. Landing

Altitude	Sea level to 8000 feet
Ambient Temperature	
Maximum	ISA + 35°C
Minimum	ISA - 50°C
Tailwind Component	10 knots

C. Enroute Flight Paths

Altitude	Sea level to 30, 000 feet
Ambient Temperature	
Maximum	ISA + 35°C
Minimum	ISA - 50°C

4. Power Plant Limitations

A. Engine Limitations

(1) Number and Type:	4 Rolls-Royce Tyne 12 Mk 515
(2) Manufacturer:	Rolls-Royce Limited

Operating Condition	Propeller Shaft hp	Jet Thrust (lb)	Max HP rpm	Max LP rpm	Max TGT °C (at sea level)	Time Limit
Take-off	5,095	1,065	18,150 (102.9%)(a)	15,250 (99.8%)(a)	735 (b) 665 (b)	5 minutes Post RR. Mod. 1426
Maximum Continuous	4,685	940	17,950 (101.7%)(a)	14,500 (94.9%)(a)	715 (b) 645 (b)	Post RR. Mod. 1426
Maximum Reverse Thrust			16,600 (94.1%)(a)	13,250 (86.7%)(a)	685 620	1 minute 1 minute Post Mod. 1426

NOTES: (a) Corresponding reading of tachometer with zero instrument error.

(b) TGT limits increase by 2-1/2°C per 1000 feet of altitude.

B. Air Turbine Starter

(1) Starter operating time must not exceed 40 seconds during any one starting attempt.

(2) A maximum of 3 consecutive 40-second starts may be carried out in succession, provided that a minimum period of one minute elapses from end of one operation to start of the next.

(3) A 15-minute cooling period must follow any 3 consecutive 40-second operations.

(4) The starter may be operated for any number of 30-second operations provided a minimum of three minutes elapses between successive operations.

(5) Starter inlet temperature limits and corresponding pressure limits.

Maximum	310°C	26 psig
Intermediate	150°C	32 psig
Minimum	-30°C	32 psig

(6) Starter system pressure and temperature limits at ground connection.

Maximum pressure	34 psig
Maximum temperature	270°C
Minimum temperature	20°C

C. Fuel System Limitations

Total usable fuel quantity 9,992 Imperial (12,000 US) gallons

(1) Fuel Grades

Grade (Type)	Specification
Kerosene Type (AVTUR: JP.1)	D. Eng.R.D. 2453 Issue 4 D. Eng.R.D. 2494 Issue 8 A.S.T.M. D1655-78 JET A A.S.T.M. D1655-78 JET A-1 CAN 2-3, 23-M78 (Canadian) MIL-T-83133 (JP.8) I.A.T.A. 1978: Kerosene type AIR 3405/C (French) U.S.S.R. T-1 & TS-1 (GOST 10227-62) U.S.S.R. T-7 (GOST 12308-66) U.S.S.R. RT (GOST 16564-71) Romanian State (3754/73) (CS-3) Romanian State STAS 5639
Wide-Cut Fuel (AVTAG: JP.4)	D. Eng.R.D. 2454 Issue 4 D. Eng.R.D. 2486 Issue 9 A.S.T.M. D1655-78 JET B I.A.T.A. 1978 JP.4 type CAN 2-3.22 M78 (Canadian) MIL-T-5624K JP.4 grade AIR 3407/B (French) TL 9130-006 Issue 5 (German) U.S.S.R. T-2 (GOST 10027-62)
High Flash Point (AVCAT: JP.5)	D. Eng. R.D. 2452 Issue 2 D. Eng. R.D. 2498 Issue 7 3-GP-24g (Canadian) MIL-T-5624K JP.5 grade AIR 3404/C (French) TL 9130-007 Issue 4 (German)

NOTE: Fuel specification D. Eng. R.D. 2453 and D. Eng. R.D. 2454 already include a corrosion inhibitor to D. ENG. R.D. 2461 and anti-icing additive to Specification D. Eng. R.D. 2451 (Issue 2 or later issue) to approved limitations.

(a) Approved Deviations

Fuels with the following deviations from Specific D. Eng. R.D. 2494 are acceptable e.g. U.S.S.R. fuels T1, TS-1, T-7 and RT and Canadian Can 2-3.23-M78.

Flash point - Minimum 28 deg.C. (82.4 deg.F)
Mercaptan sulphur - Maximum 0.005 per cent. by weight

(b) Optional Additives

The following additives (additional to those included in the above D. Eng. R.D. Specifications) are approved by Rolls-Royce Limited subject to the limitations stated:

(i) Corrosion inhibitor/lubricity aids

Additive	Concentration Range - lb/35000 Imp.Gallons(mg/l)	
	Minimum	Maximum
Hitec E515	4 (11 mg/l)	7.5 (21 mg/l)
Apollo PRI 19	3 (9 mg/l)	8 (23 mg/l)
Tolad 245	7.5 (21 mg/l)	12 (34 mg/l)
Emery 9855	4.5 (13 mg/l)	12 (34 mg/l)
DuPont DCI-4A	3 (9 mg/l)	8 (23 mg/l)
Hitec E580	3 (9 mg/l)	8 (23 mg/l)
NALCO 5403	3 (9 mg/l)	8 (23 mg/l)

NOTE: The minimum requirement is to ensure that sufficient additive is available when it is required to act as a lubricity aid.

(ii) Anti-icing Additives - Max. concentration 0.15 per cent. by volume.

a - D. Eng. R.D. 2451 (Issue 2)
*b - D. Eng. R.D. 2451 (Issue 1) or any exact equivalent.
c - MIL-1-27686E

* - It is preferred that additive b is not used.

(2) Fuel Pressure

Minimum inlet fuel pressure at high pressure pump 9 psi

(3) Booster Pumps

The booster pumps in tanks supplying engines must be on and operating for take-off.

D. Oil System Limitations

(1) Oil Grade

Engine and Accessory Gear-Box	Esso Aviation Turbo Oil 35 (also marketed as Enco Turbo Oil 35) Penola Turbine Oil 35 Humble Turbine Oil 35 Castrol 98
Constant Speed Drive	Oils conforming to MIL-L-7808

(2) Engine Oil Temperatures

Minimum for ground starting	-30°C
Minimum for opening up or air relight starting	-15°C
Maximum - unrestricted	
Castrol 98	105°C
Other approved oils	100°C
Maximum - 15-minute limit	
Castrol 98	110°C
Other approved oils	105°C

(2A) Engine Turbine Bearing Oil Temperature

If observed engine turbine bearing scavenge oil temperature exceeds 180°C during cruising flight, the engine should be shut down to preclude hazardous structural failure.

(3) Constant Speed Drive Temperature

Minimum for starting	-40°C

(4) Engine Oil Pressures

Normal (at 90°C)	40 to 65 psi at 14,500 LP rpm (94.9%)
Minimum (at 100°C)	40 psi at 14,500 LP rpm (94.9%)
Minimum to complete flight	38 psi at 11,000 LP rpm and above; 30 psi at all rpm below 11,000 LP rpm

(5) Accessory Gear-box Oil Pressure

Minimum for operation	16 to 19 psi (warning light out)

E. Additional Turbine Gas Temperature Limitations

Maximum during start	800°C (momentary) 725°C (momentary) Post RR Mod 1426

F. Additional RPM Limitations

Maximum overspeed (20 seconds)	16, 800 (110.0%) LP rpm
Maximum overspeed (20 seconds)	18, 600 (105.5%) HP rpm
Minimum for approach	10 500 (68.8%) LP rpm
Minimum GR/Idle	11, 100 (72.8%) LP rpm
Restricted rpm band	6, 500 (42.5%) to 8, 500 (55.6% LP rpm

NOTE: When the aircraft is stationary, operate the engine with the power lever in the GR RUN position.

G. Propeller Limitations

Manufacturer	deHavilland Propellers Limited
Number and Model	4 Model PD 228/476/2
Blades	4
Diameter	16 feet (+0.14 inches, -1.00 inches)
Rotation	Counter-clockwise tractor (viewed from the rear)

(1) Pitch Settings at Station 72.0 Inches (75%)

Maximum reverse	-17° (Mechanical stop)
Ground Idle	-7° (BETA detent)
Flight Idle	+12° (Hydraulically withdrawable mechanical stop)
Feather	+83° (Mechanical stop)

The automatic drag limiting system (ADLS) must be operational for take-off. The power levers must not be moved aft of the FLIGHT IDLE position while the aircraft is airborne.

(2) DELETED

Time limit for the operation of the feather pump on the ground is 2 minutes; a 30 minutes pump cooling period must be allowed for between duty cycles.

5. Airspeed Limitations

		ALT 1000 FT	KNOTS		MACH	
			IAS	CAS	M_{IND}	M
MAXIMUM SPEED FOR FLIGHT TESTING OR PILOT TRAINING The maximum speed or Mach number authorized for flight testing or pilot training operations.	Zero Fuel Weights 135,000 lb or less.	SL	309	306		
		10	309	306		
		15	309	306		
		20			0.63	0.62
		25			0.63	0.62
		30			0.63	0.62
	Zero Fuel Weights 135,000 lb to 145,000 lb.	SL	294	292		
		10	294	292		
		15	294	292		
		20			0.63	0.62
		25			0.63	0.62
		30			0.63	0.62
	Zero Fuel Weights 145,000 lb to 155,000 lb.	SL	280	278		
		10	280	278		
		15	280	278		
		20	280	278		
		25			0.63	0.62
		30			0.63	0.62

V_{MO}/M_{MO} MAXIMUM OPERATING LIMIT SPEED

The maximum operating limit speed or Mach number, V_{MO}/M_{MO}, varies with altitude and with zero fuel weight, and is presented for eleven zero fuel weights.

V_{MO}/M_{MO} shall not be deliberately exceeded in any regime of flight (climb, cruise, or descent), except where a higher speed is specifically authorized for flight test or pilot training operations, or for approved emergency procedures.

At sea level the "SL" pointer indicates the permissible V_{MO}.

From sea level to 20,000 feet, the permissible V_{MO} varies linearly between the "SL" and "20" pointers. For example, at 10,000 feet the permissible V_{MO} is just half-way between the "SL" and "20" pointers.

At 20,000 feet, and above, the "20" pointer indicates either the permissible V_{MO} or the airspeed corresponding to the permissible M_{MO}, whichever is lesser

V_{MO}/M_{MO} LIMITATIONS

Altitude (1000 ft)	SL to 10	10 15	15 20	20 25	25 30
ZFW (lb)	Kts IAS	Kts IAS	Kts IAS	Kts IAS	Mach M_{IND}
155000	251	253	255	258	0.63
153000	253	255	257	260	0.63
151000	256	258	260	263	0.63
149000	258	260	262	265	0.63
147000	261	263	265	268	0.63
145000	263	265	267	270	0.63
143000	266	268	270	273	0.63
141000	268	270	272	275	0.63
139000	271	273	275	278	0.63
137000	273	275	277	280	0.63
135000 or less	276	278	280	283	0.63

Prior to each take-off, set the Airspeed Limit Datum and the V_{MO}/M_{MO} Aural Warning Selector as prescribed below. Do not reset in flight.

(a) Set "SL" limit pointer to the "SL" V_{MO} shown for the nearest higher ZFW.

(b) Set the Aural Warning Selector to the nearest higher ZFW of the V_{MO}/M_{MO} limitations table or placard.

		KNOTS		MACH	
		IAS	CAS	M_{IND}	M
V_{FE}	MAXIMUM FLAP EXTENDED SPEED. The maximum speed with the flaps in a prescribed extended position:				
	Flap extended 5°	234	230	0.51	0.50
	Flap extended 15°	234	230		
	Flap extended 30°	203	198		
	Flap extended 45°	153	150		
	For emergency descent when above 14,000 feet	176	171		
V_A	MANOEUVRING SPEED. The maximum speed for severe manoeuvring. Extreme application of primary flight controls should be confined to speeds below this value.	209	210		
V_{LO}	MAXIMUM LANDING GEAR OPERATING SPEED. The maximum speed at which the landing gear may be raised or lowered safely.	179	180		
V_{LE}	MAXIMUM LANDING GEAR EXTENDED SPEED. The maximum speed at which the aircraft can be flown safely with the landing gear extended and locked.	183	184		
V_{MCA}	MINIMUM CONTROL SPEED. ADLS operative. (Sea level standard day)	104	103		
	MAXIMUM LANDING LIGHT OPERATING SPEED.	165	165		
	MAXIMUM LANDING LIGHT EXTENDED SPEED.	209	210		
	MAXIMUM FUEL DUMP CHUTE OPERATING AND EXTENDED SPEED.	209	210		
	MAXIMUM WING SPOILER OPERATING SPEED.	199	200		

6. Flight Load Acceleration Limits

Flaps Retracted	
At all speeds up to V_{MO} or M_{MO}	-1.0 G to +2.5G
At all speeds in excess of V_{MO} or M_{MO}	0.0 G to +2.5G
Flaps Extended - all speeds up to V_{FE}	
Flaps extended 5°	0.0G to +2.5G
Flaps extended 15° to 45°	0.0G to +2.0G

7. Minimum Flight Crew

The minimum flight crew required for performing all functions necessary to comply with the airworthiness standard is three (3):

1 Pilot

1 Co-pilot

1 Systems Operator

8. Type of Aircraft Operation

The CL-44D4 is certificated in the Transport Category under the appropriate portions of the U.S. Civil Air Regulations, Part 4b, and Special Civil Air Regulation 422B dated 9th July, 1959. When required equipment is installed and operational, operation is permitted at night and under IFR conditions.

9. Maximum Approved Operating Altitude

For aircraft engaged in carriage of cargo, the maximum operating altitude is 30,000 feet.

10. Auto Pilot Limitations

The CL-44D4 incorporates the Eclipse-Pioneer PB-20H auto pilot system.

The auto pilot is approved for operation up to V_{NE} speed. With the auto pilot engaged, the following airspeed limits must be observed for operation of the flaps:

Extending flaps	180 knots IAS maximum
Retracting Flaps	160 knots IAS maximum

When the glide slope function is engaged, damping is provided over the automatic manoeuvring which progressively reaches a maximum after a loss of 1500 feet in altitude. Therefore engagement of the automatic glide slope function above 1500 feet will possibly result in insufficient manoeuvring sensitivity during final approach.

11. Icing Limitation

The CL-44D4 aircraft is approved for operation in atmospheric icing conditions.

12. Power Plant Anti-icing and De-icing Systems Limitations

The power plant anti-icing and de-icing systems must not be operated in ambient temperatures above 10°C.

13. Wing Anti-icing Systems Limitations

The wing anti-icing system must not be operated in ambient temperatures above 10°C.

14. Windshield Heat Limitation

For compliance with bird-penetration strength requirements, the windshield heat must be on at all times during flight at airspeeds in excess of 200 knots IAS in the attitude range Sea Level to 10,000 feet.

15. Pressurization Limitations

Maximum operating differential pressure	6.55 psi
Outflow valve relief setting	6.9 psi

The airplane must not take off or land with the cabin pressurized.

16. Miscellaneous Limitations

A. Instrument Marking Colour Code

Red radial line	Limit of operation
White radial line (long) on TGT indicator	Maximum for starting
Red dots forming an arc on TGT indicator	Range of Take Off and Maximum Continuous TGT limits variable with altitude
White radial line (long) on RPM indicators	Maximum overspeed for 20 seconds
Red arc	Restricted operating range
Yellow arc	Take-off and caution range
Green arc	Normal operating range
White radial line (short)	Alignment index or check points

B. Oxygen System Limitations

Deleted

C. Hydraulic System Limitations

Normal operating pressure	2700 to 3000 psi
Maximum operating pressure	3125 psi

D. Electrical System Limitations - Variable-frequency A.C.

The electrical load limitations for any one variable-frequency a.c. generator are as follows:

LOAD	TIME LIMIT
60.0 KVA	Continuous
90.0 KVA	5 minutes
120.0 KVA	5 seconds
Ground Running 20 KVA	15 minutes

E. Electrical System Limitations - Constant-frequency A.C.

The electrical load limitations for any one constant-frequency a.c. generator are as follows:

LOAD	TIME LIMIT
40.0 KVA	Continuous
60.0 KVA	5 minutes
80.0 KVA	5 seconds

F. Ground Running

LOAD	TIME LIMIT
25.0 KVA	15 minutes

G. Electrical System Limitations - D.C.

The d.c. limitations per d.c. power supply unit are as follows:

POWER SUPPLY CAPACITY	TIME LIMIT
200 amperes	Continuous

300 amperes	2 minutes
500 amperes	5 seconds

H. Wing Spoiler Limitations

Spoiler system must be operative for take-off.

I. Anti-skid System Limitations

All anti-skid units must be operative for take-off.

J. Fuel Dumping Limitations

For jettisoning fuel in level flight, normal descent, or all-engine clim wing flaps may be in the retracted or take-off (15°) position. For jettisoning fuel in climb attitude with one or more engines inoperative, use only Take-off flap position.

K. Swing Tail Operating Limitations

The swing tail must be in a closed position and latched when winds are in excess of 60 mph.

For operation of the swing tail, the maximum permissible wind velocit component normal to the fin is 30 mph. When operating the swing tail with winds in excess of 30 mph, the airplane must be so positioned that the wind component tending to assist the opening or closing of the tail does not exceed 30 mph.

Following operation of the swing tail, the lock pins must be visually checked by a member of the Flight Crew prior to take-off.

Engine No. 1 may be run between GR RUN and MAX. BETA power settings to provide auxiliary power for operating the swing tail. Engine No. 2, 3 or 4 must not be run with the swing tail open or operating.

No ground manoeuvring or jacking of the aircraft is permitted when the swing tail is unlatched.

L. Nose Wheel Steering Limitation

The minimum nose wheel load consistent with adequate control of the airplane on the ground is 5,000 pounds with a corresponding oleo pressu of 200 psi.

17. Maximum Take-off Weight Permitted by Climb Requirements

The maximum take-off weight permitted by climb requirements for varying airport altitudes and temperatures is shown in Figure 1.

The critical configuration is the gear-up take-off configuration of 4T.120(b) and is defined as follows:

Airplane Configuration:

Landing gear	Retracted
Wing flaps	15°
Engines	One engine inoperative and propeller feathered. Operative engines at Take-off Power.
Airspeed	V_2 (Sect 4, Fig. 4.)
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

Example

The example given shows that at a pressure altitude of 1500 feet and an ambient temperature of 22°C (ISA + 10°C) the maximum permissible take-off weight is 201,200 pounds.

NOTES: (1) Use of this chart ensures compliance with all the appropriate climb requirements contained in Regulation SR-422B.

(2) At a particular airport the allowable take-off weight may be less than the appropriate maximum permissible take-off weight obtained from this chart because of the field length or take-off flight path obstacle clearance becoming critical.

(3) The change in slope at line A-A on Figure 1 is caused by the engine operating characteristics.

18. Maximum Take-off Weight Permitted by Take-off Field Length Requirements

The information given in Figure 2 enables the maximum take-off weight to be determined for a given airport field length at varying ambient temperatures, airport altitudes, runway gradients and reported wind components.

The maximum take-off weight is limited by the four-engine take-off distance requirements of Paragraph 4T.117(a) (2) of SR-422B, this distance being greater than the corresponding accelerate-stop distance and take-off distanc to 35 feet with an engine failure at the scheduled V_1 speeds (Sect. 4, Fig. 2).

Associated Conditions:

Landing Gear	Retraction initiated upon lift-off
Wing flaps	15°
Engines	Take-off Power
Runway	Hard, dry surface
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

At light weights the engine-out controllability limitation overrides the norma take-off speeds and this has necessitated the separation of the altitude-temperature grid on the left-hand side of Figure 2 into two parts. The upper part B is used for the normal take-off speeds and the lower part A when the engine-out controllability speeds are limiting. To find which part of the grid to use, first determine the take-off weight limited by climb performance from Figure 1. Using this weight and the ambient conditions, determine the take-off safety speed (V_2) from Sect. 4, Fig. 4. Note whether part A or B on this figure is limiting and use the corresponding grid on Figure 2. The following example illustrates this general case.

Example 1 (Single arrows)

At an ambient temperature of 22°C (ISA +10°C) and a pressure altitude of 1500 feet, Figure 1 gives a take-off weight limit of 201,200 pounds. Entering Sect. 4. Fig. 4 with these conditions gives a V_2 from A of 116 knots IAS and from B 136 knots IAS. Hence part B is limiting.

Entering with the ambient conditions into grid B of Figure 2 shows that with a runway length of 7430 feet, a gradient of 1.1% uphill and a reported headwind of 14 knots, the maximum take-off weight is 192,200 pounds, which is less than the take-off weight limit from Figure 1 and is therefore limiting. The value of V_2 for this limiting weight can then be read from Sect. 4, Fig. 4.

Example 2 (Double arrows)

This second example is given to illustrate the method of determining the take-off weight when engine-out controllability limits the take-off speeds. The example is arranged to fall within the area bounded by the dotted lines, this area being the overlap of the two weight grids for the appropriate A or B grid.

At an ambient temperature of 22°C (ISA + 7°C) and a pressure altitude of sea level, Figure 1 gives a take-off weight of 205,000 pounds. Entering Sect. 4, Fig. 4 with these conditions gives a take-off safety speed V_2 from A of 120 knots IAS and from B 137 knots IAS. Hence part B is limiting.

Entering grid B on Figure 2 with these ambient conditions (identified by circles), shows that with a runway length of 5100 feet, a gradient of 2% uphill and a reported tailwind of 9 knots, the maximum take-off weight is 152,500 pounds. The intersection occurs within the scope of the weight grid applicable to grid B (i.e., above the lower dashed line) and therefore cannot be immediately rejected. This weight is less than the take-off weight from Figure 1 and is therefore limiting. On checking the V_2 speed for this limiting weight from Sect. 4, Fig. 4, it is found that the V_2 from A is 120 knots IAS and from B 119 knots IAS; hence part A is now limiting.

As this is so, it is necessary to recalculate the take-off weight by entering grid A on Figure 2 with the ambient conditions (identified by squares) and for the same runway conditions it is found that the take-off weight is 150,000 pounds. On checking the new V_2 speed from Sect. 4, Fig. 4, it is found that V_2 from A is 120 knots IAS and from B 118 knots IAS, therefore part A is still limiting. The limiting take-off weight is therefore 150,000 pounds and the take-off safety speed V_2 is 120 knots IAS.

NOTE: The wind grid is factored; reported wind may be used directly.

19. Maximum Landing Weight Permitted by Climb Requirements

The maximum landing weight permitted by climb requirements for varying airport altitudes and temperatures is shown in Figure 3.

At conditions to the right of line B-B on Figure 3, the critical configuration is the All-engines-operating Landing Climb configuration of 4T.119, and is defined as follows:

Aircraft Configuration:

Landing gear	Extended
Wing flaps	45°

Engines	All engines at Take-off Power
Airspeed	Sect. 4, Fig. 5
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

At conditions to the left of line B-B Figure 3, the critical configuration is the 3-engine Approach Climb configuration of 4T-120(d) and is defined as follows:

Aircraft Configuration:

Landing gear	Extended
Wing flaps	30°
Engines.	One engine inoperative and propeller feathered. Operative engines at Take-off Power.
Airspeed	Sect. 4, Fig. 5
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

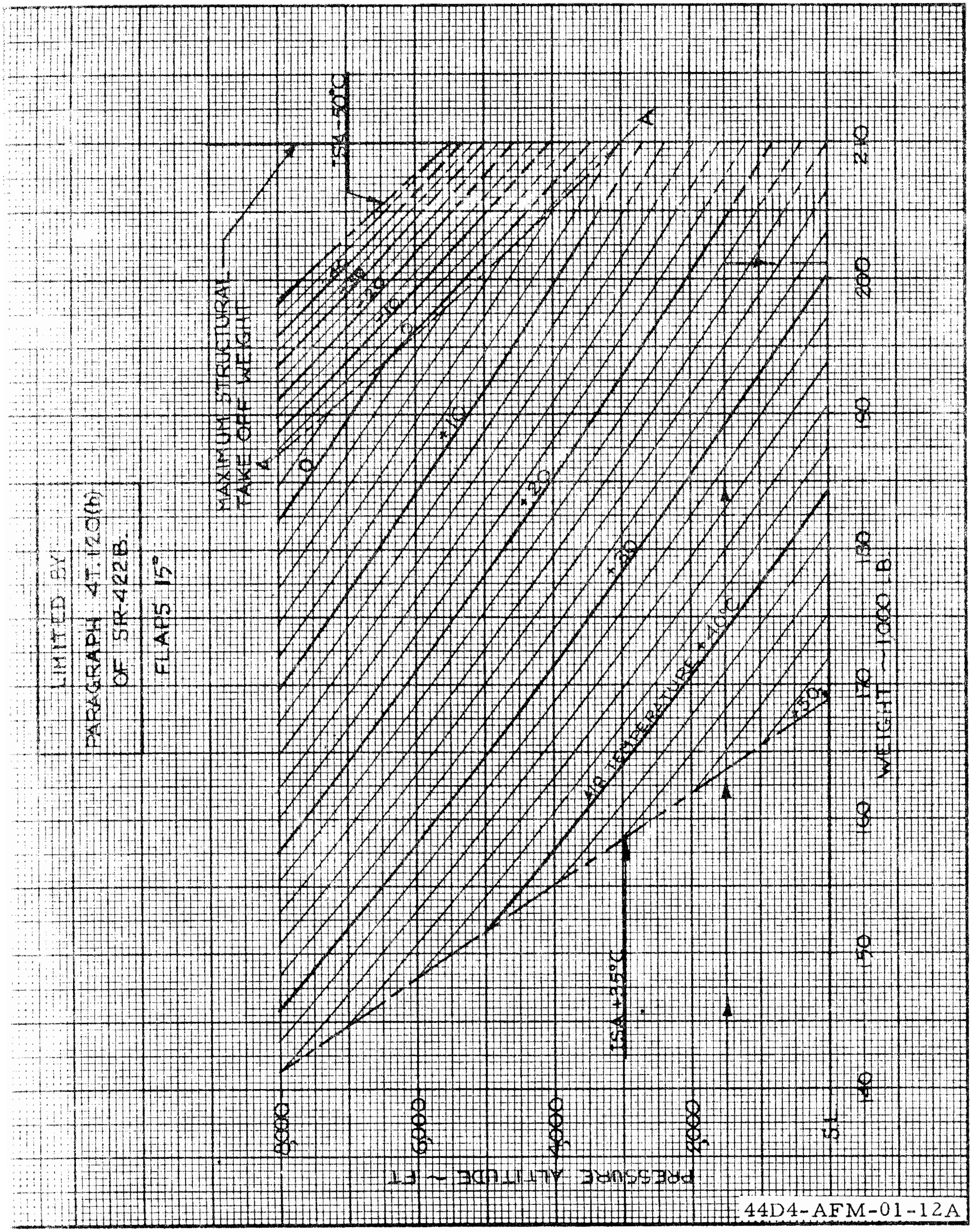
Example

The example given shows that at a pressure altitude of 1500 feet and an ambient temperature of 32°C (IAS + 20°C) the maximum permissible landing weight is 162, 800 pounds.

NOTES: (1) Use of this chart ensures compliance with all the appropriate climb requirements contained in Regulation SR-422B.

(2) At a particular airport, the allowable landing weight may be less than the appropriate maximum permissible landing weight obtained from this chart because of landing field length becoming critical.

(3) The change in slope at line A-A in Figure 3 is caused by the engine operating characteristics.



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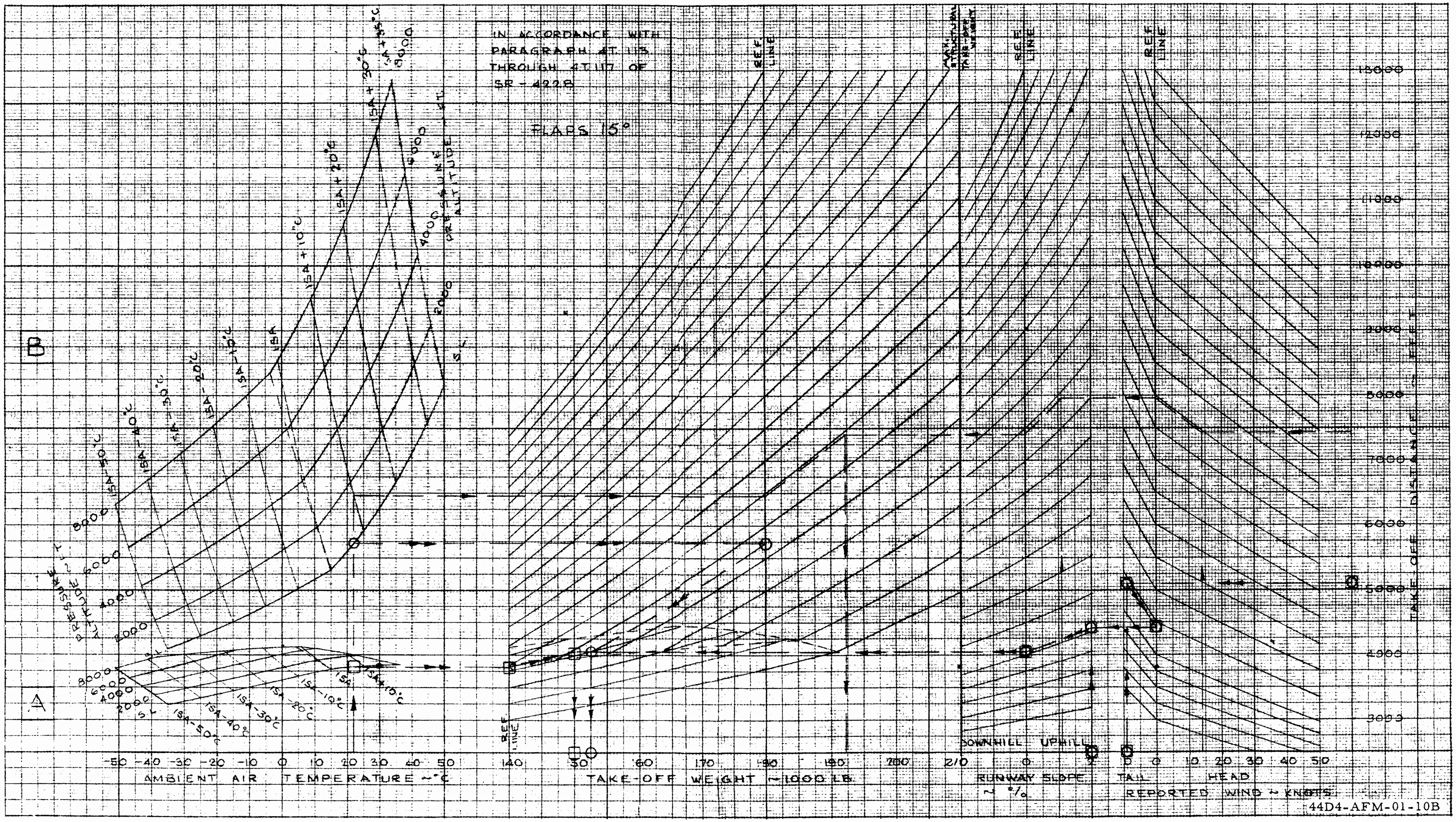
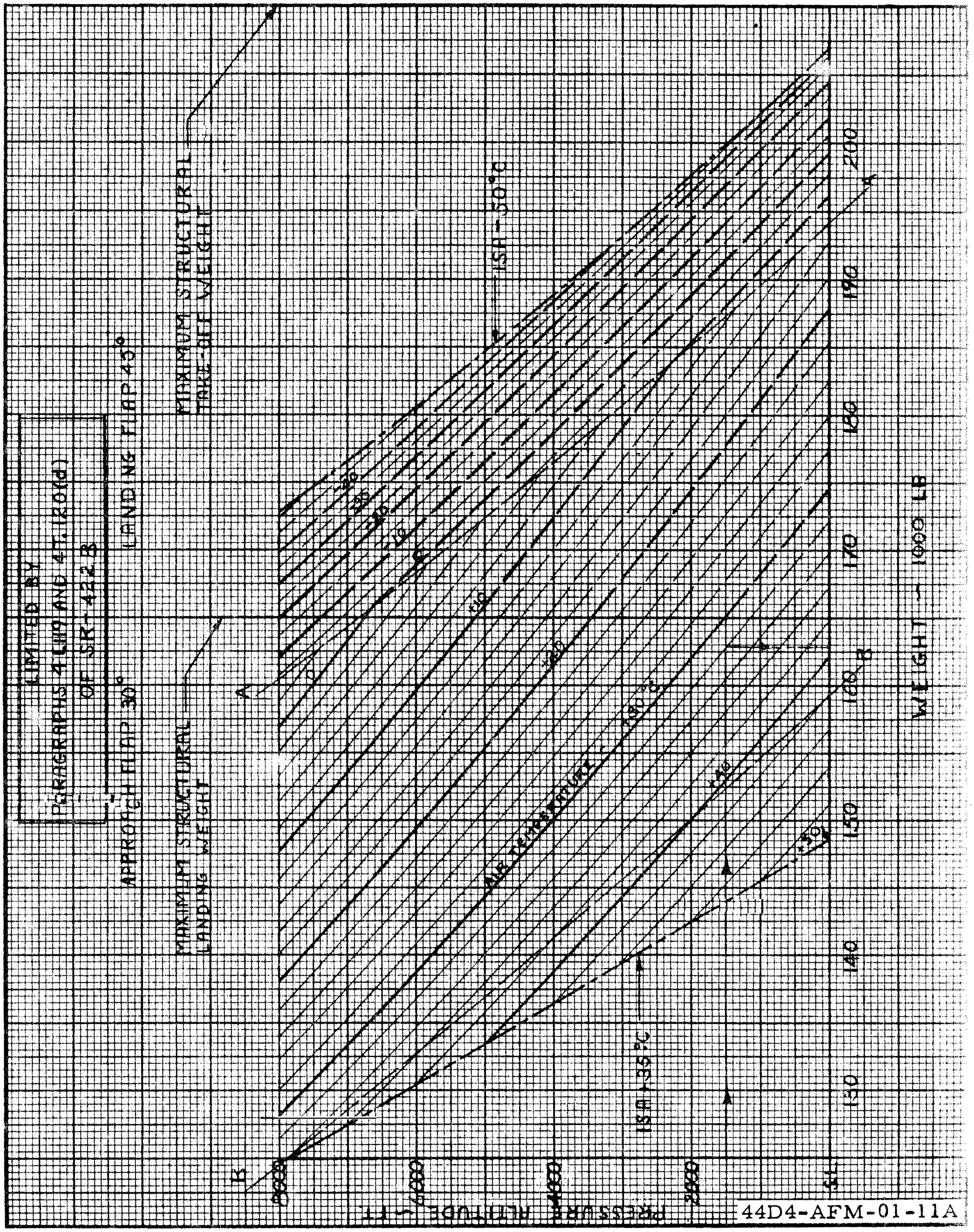
Maximum Take-off Weight Permitted by Climb Requirements

Figure 1

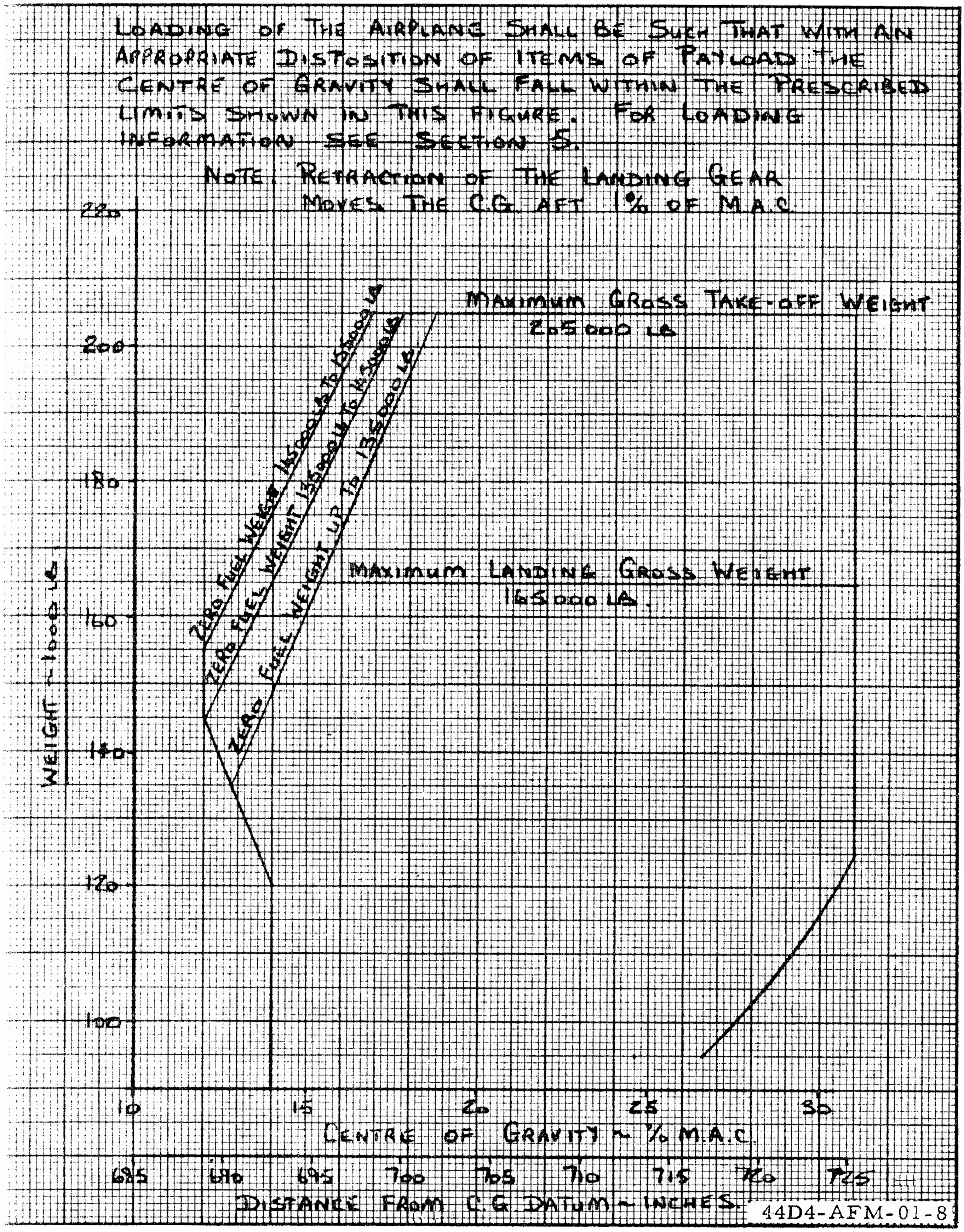

IN ACCORDANCE WITH PARAGRAPH 4T.115 THROUGH 4T.117 OF SR-422B

FLAPS 15°

Maximum Take-off Weight Permitted by Take-off Field Length Requirements
Figure 2



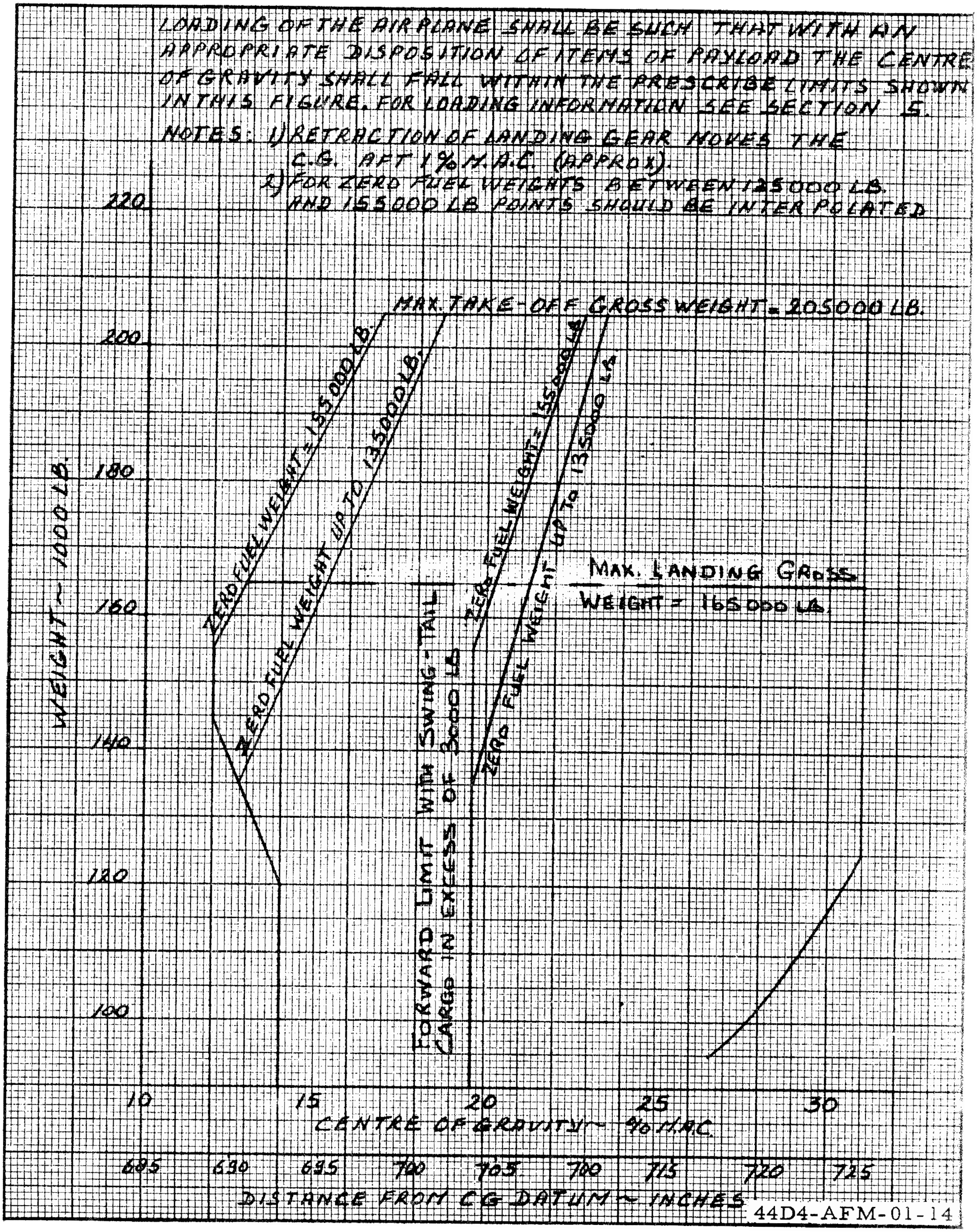
Maximum Landing Weight Permitted by Climb Requirements
Figure 3



LOADING OF THE AIRPLANE SHALL BE SUCH THAT WITH AN APPROPRIATE DISTOSITION OF ITEMS OF PAYLOAD THE CENTRE OF GRAVITY SHALL FALL WITHIN THE PRESCRIBED LIMITS SHOWN IN THIS FIGURE. FOR LOADING INFORMATION SEE SECTION 5.

NOTE: RETRACTION OF THE LANDING GEAR MOVES THE C.G. AFT 1% OF M.A.C.

Centre of Gravity Envelope - Gear Extended (Basic Aircraft)
Figure 4 (1 of 4)

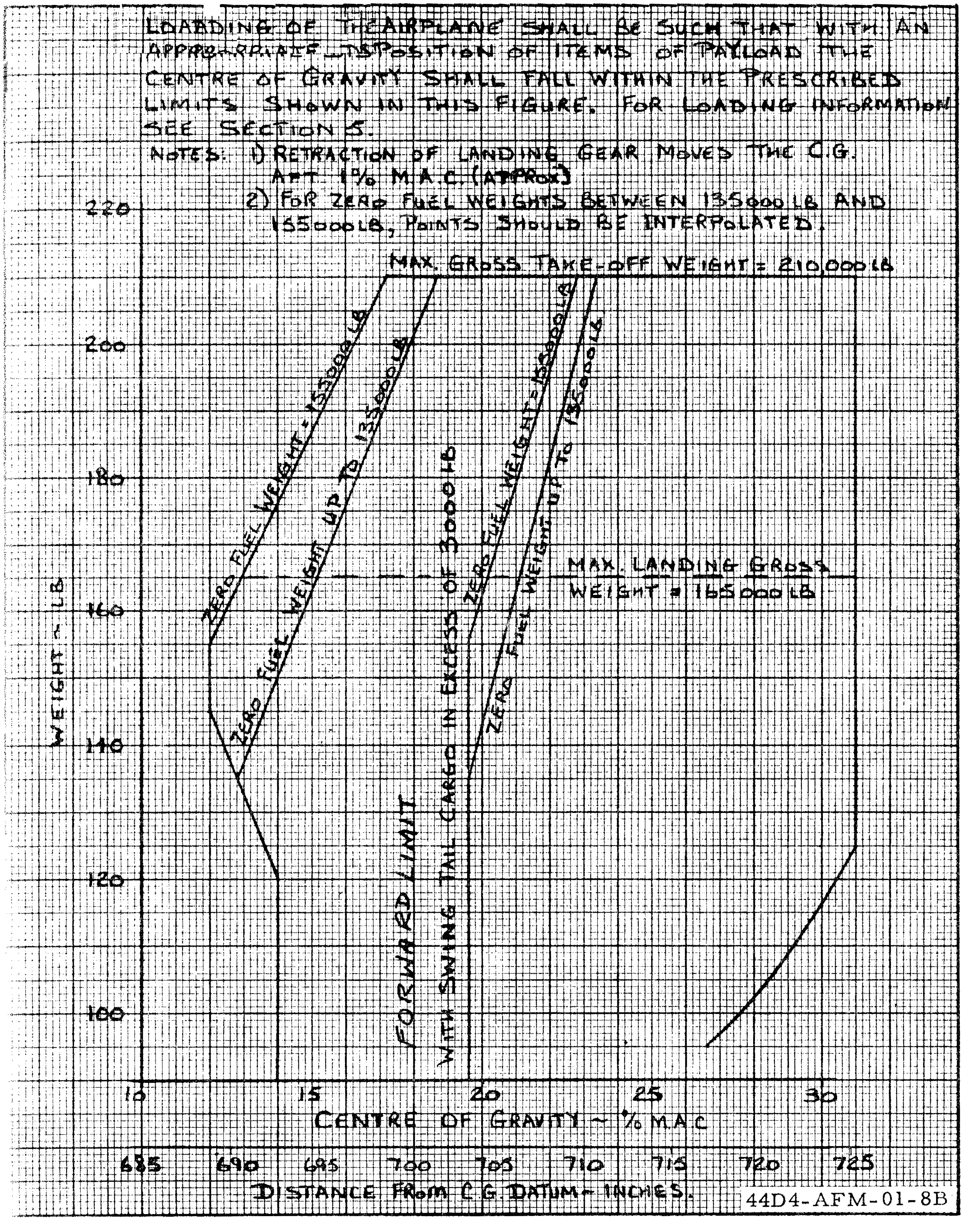

LOADING OF THE AIRPLANE SHALL BE SUCH THAT WITH AN APPROPRIATE DISPOSITION OF ITEMS OF PAYLOAD THE CENTRE OF GRAVITY SHALL FALL WITHIN THE PRESCRIBE LIMITS SHOWN IN THIS FIGURE. FOR LOADING INFORMATION SEE SECTION 5.

NOTES: 1) RETRACTION OF LANDING GEAR MOVES THE C.G. AFT 1% M.A.C. (APPROX).
2) FOR ZERO FUEL WEIGHTS BETWEEN 125000 LB. AND 155000 LB POINTS SHOULD BE INTERPOLATED

WEIGHT ~ 1000 LB.
220
200
180
160
140
120
100
MAX. TAKE-OFF GROSS WEIGHT = 205000 LB.
ZERO FUEL WEIGHT = 155000 LB.
ZERO FUEL WEIGHT UP TO 135000 LB.
ZERO FUEL WEIGHT = 155000 LB
ZERO FUEL WEIGHT UP TO 135000 LB
MAX. LANDING GROSS WEIGHT = 165000 LB.
FORWARD LIMIT WITH SWING-TAIL CARGO IN EXCESS OF 3000 LB
10
15
20
25
30
CENTRE OF GRAVITY ~ % M.A.C.
685
690
695
700
705
700
715
720
725
DISTANCE FROM CG DATUM ~ INCHES

44D4-AFM-01-14

Centre of Gravity Envelope - Gear Extended
(Basic Aircraft Modified to CL44D4-245)
Figure 4 (2 of 4)

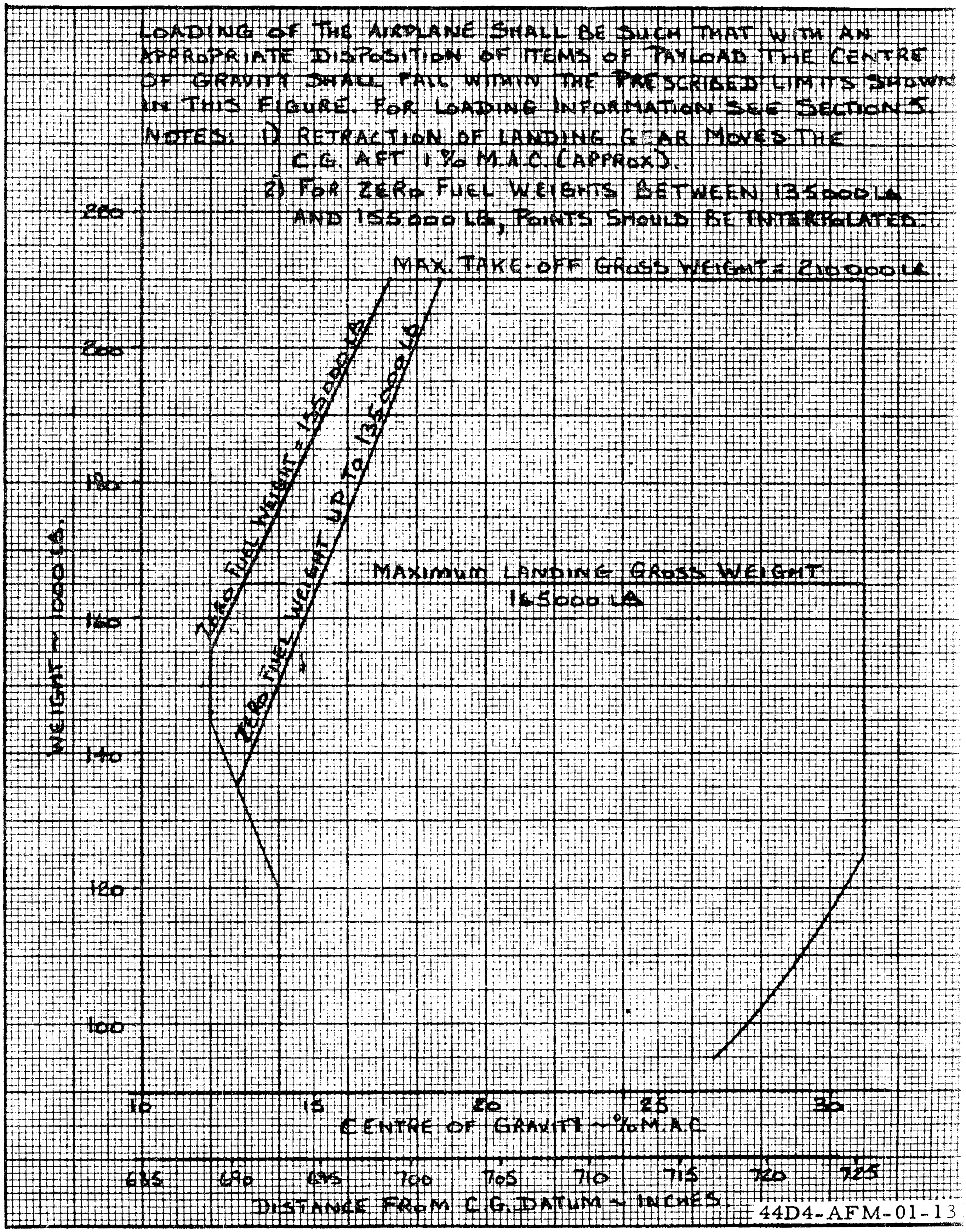


LOADING OF THE AIRPLANE SHALL BE SUCH THAT WITH AN APPROPRIATE DISPOSITION OF ITEMS OF PAYLOAD THE CENTRE OF GRAVITY SHALL FALL WITHIN THE PRESCRIBED LIMITS SHOWN IN THIS FIGURE. FOR LOADING INFORMATION SEE SECTION 5.

NOTES: 1) RETRACTION OF LANDING GEAR MOVES THE C.G. AFT 1% M.A.C. (APPROX)
2) FOR ZERO FUEL WEIGHTS BETWEEN 135000 LB AND 155000 LB, POINTS SHOULD BE INTERPOLATED.

MAX. GROSS TAKE-OFF WEIGHT = 210,000 LB
MAX. LANDING GROSS WEIGHT = 165000 LB
ZERO FUEL WEIGHT = 155000 LB
ZERO FUEL WEIGHT UP TO 135000 LB
ZERO FUEL WEIGHT = 155000 LB
ZERO FUEL WEIGHT UP TO 135000 LB
FORWARD LIMIT
WITH SWING TAIL CARGO IN EXCESS OF 3000 LB
WEIGHT ~ LB
220
200
180
160
140
120
100
10
15
20
25
30
CENTRE OF GRAVITY ~ % M.A.C
685
690
695
700
705
710
715
720
725
DISTANCE FROM C.G. DATUM ~ INCHES.
44D4-AFM-01-8B

Centre of Gravity Envelope - Gear Extended
(Aircraft Modified to CL44D4-227 and CL44D4-245)
Figure 4 (3 of 4)



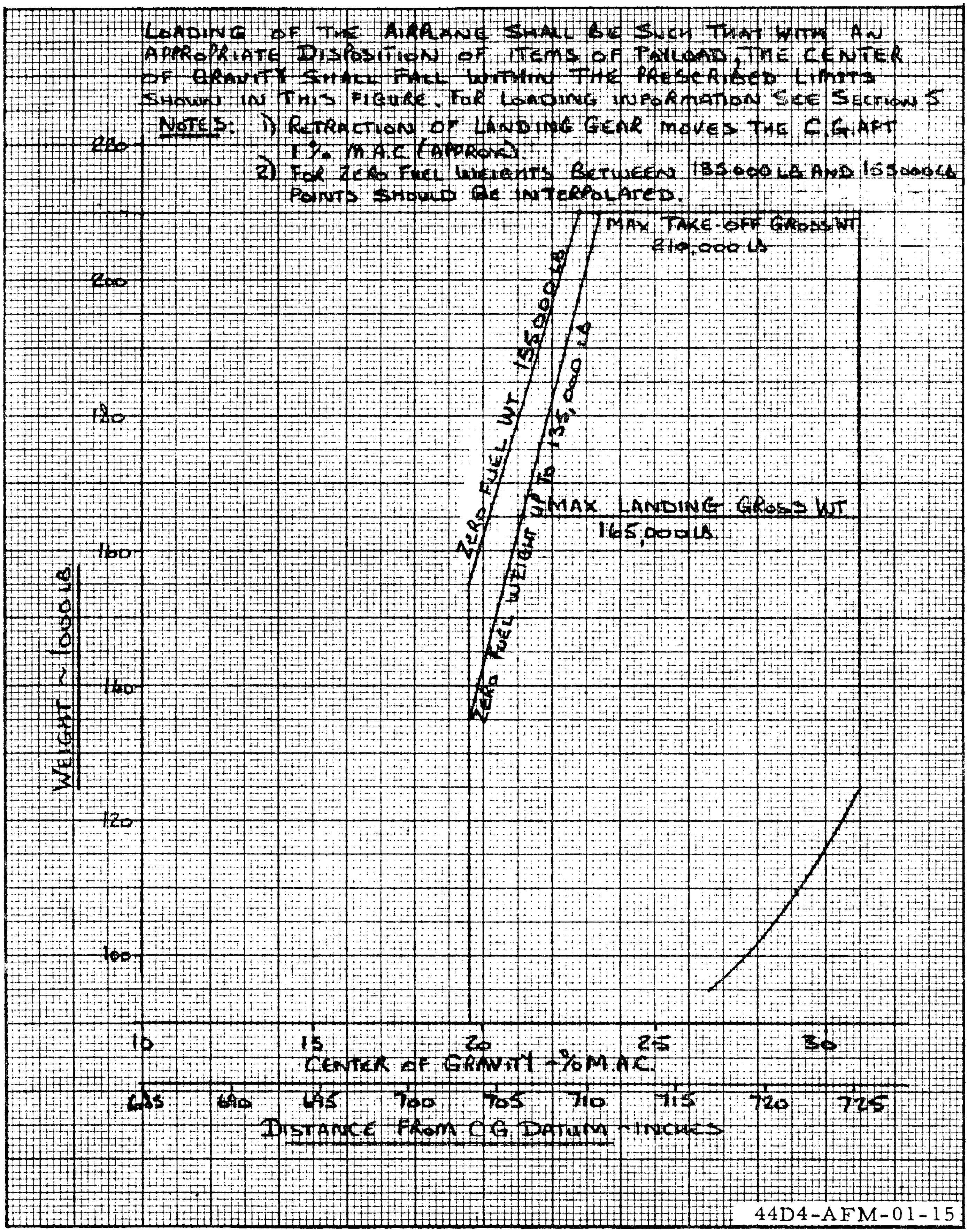
LOADING OF THE AIRPLANE SHALL BE SUCH THAT WITH AN APPROPRIATE DISPOSITION OF ITEMS OF PAYLOAD THE CENTRE OF GRAVITY SHALL FALL WITHIN THE PRESCRIBED LIMITS SHOWN IN THIS FIGURE. FOR LOADING INFORMATION SEE SECTION 5.

NOTES: 1) RETRACTION OF LANDING GEAR MOVES THE C.G. AFT 1% M.A.C. (APPROX).

2) FOR ZERO FUEL WEIGHTS BETWEEN 135000 LB AND 155000 LB, POINTS SHOULD BE INTERPOLATED.

MAX. TAKE-OFF GROSS WEIGHT = 210000 LB
ZERO FUEL WEIGHT = 155000 LB
ZERO FUEL WEIGHT UP TO 135000 LB
MAXIMUM LANDING GROSS WEIGHT 165000 LB
WEIGHT ~ 1000 LB.
220
200
180
160
140
120
100
10
15
20
25
30
CENTRE OF GRAVITY ~ %M.A.C.
685
690
695
700
705
710
715
720
725
DISTANCE FROM C.G. DATUM ~ INCHES
44D4-AFM-01-13

Centre of Gravity Envelope - Gear Extended
(Aircraft Modified to CL44D4-227 but not CL44D4-245)



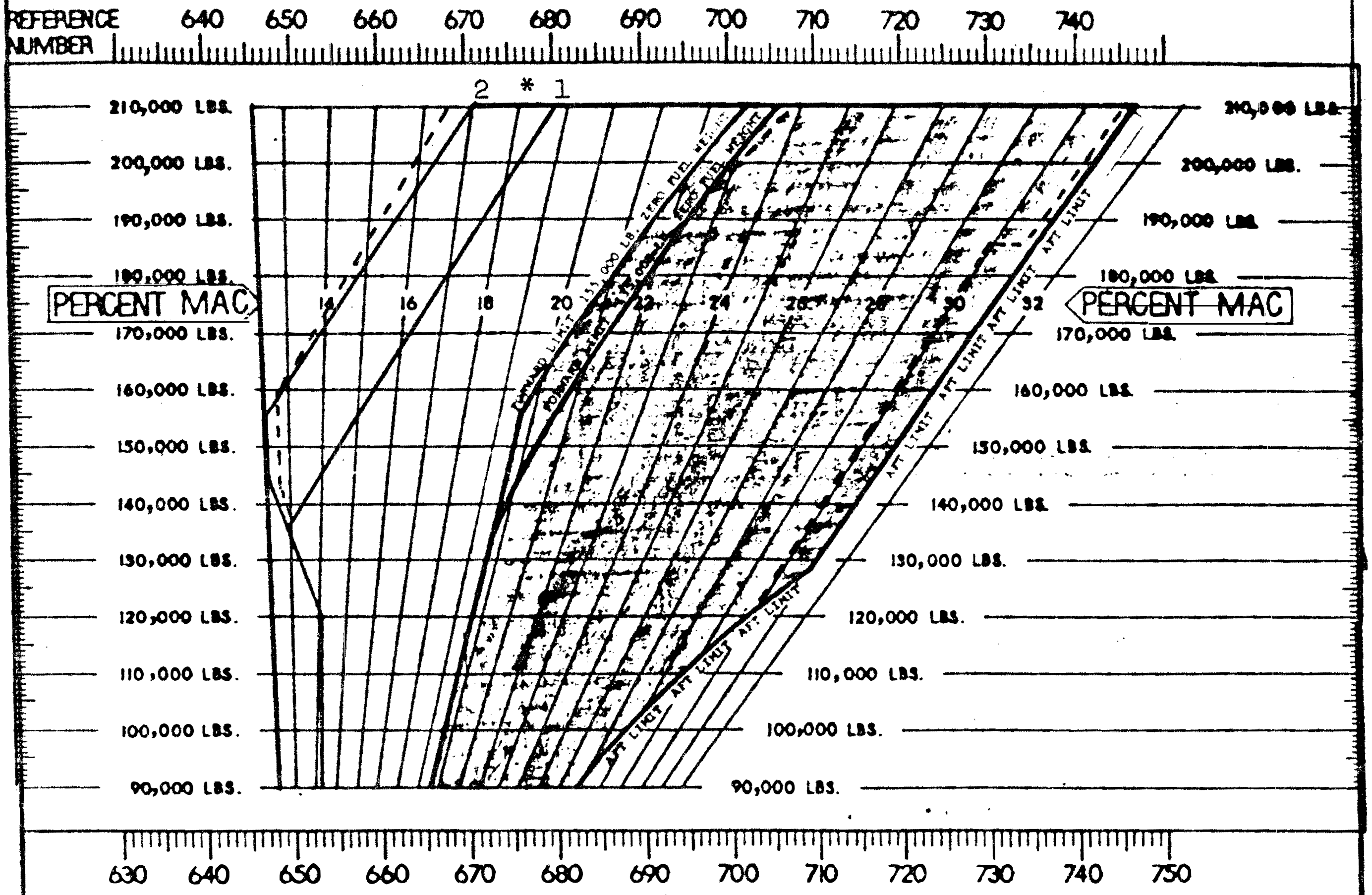
LOADING OF THE AIRPLANE SHALL BE SUCH THAT WITH AN APPROPRIATE DISPOSITION OF ITEMS OF PAYLOAD, THE CENTER OF GRAVITY SHALL FALL WITHIN THE PRESCRIBED LIMITS SHOWN IN THIS FIGURE. FOR LOADING INFORMATION SEE SECTION 5

NOTES: 1) RETRACTION OF LANDING GEAR MOVES THE C.G. AFT 1% M.A.C. (APPROX).

2) FOR ZERO FUEL WEIGHTS BETWEEN 135000 LB AND 155000 LB POINTS SHOULD BE INTERPOLATED.

220
200
180
160
140
120
100
WEIGHT ~ 1000 LB
MAX TAKE-OFF GROSS WT 210,000 LB
ZERO FUEL WT 155000 LB
ZERO FUEL WEIGHT UP TO 135,000 LB
MAX LANDING GROSS WT 165,000 LB
10
15
20
25
30
CENTER OF GRAVITY ~% M.A.C.
685
690
695
700
705
710
715
720
725
DISTANCE FROM C.G. DATUM ~ INCHES
44D4-AFM-01-15

Centre of Gravity Envelope - Gear Extended
(Passenger Configuration) (Aircraft 35 and 36)
Figure 4A



C.G. Envelope Key
*Gray area is FWD & AFT limits for A/C being loaded in excess of 3,000 lbs. in tail section.
*Solid line is FWD & AFT limits for A/C ZFW 155,000.
*Dashed line is FWD & AFT limits for A/C ZFW 160,000

← S.B. 451

* Line 1 - Forward Limit 135,000 lbs. ZF
Line 2 - Forward Limit 155,000 lbs. ZF

Center of Gravity Envelope - Gear Extended
Aircraft Modified to Canadair S.B. 451

SECTION 4

PERFORMANCE AND FLIGHT CHARACTERISTICS

1. Performance Definitions

V_S	Stalling speed or the minimum steady flight speed at which the airplane is controllable.
V_1	Critical Engine Failure Recognition speed is the maximum speed at which the pilot can recognize an engine failure during the take-off run and stop within the scheduled runway length, OR the minimum speed at which an engine failure can be experienced and the take-off safely continued without over-running the take-off flight path. It shall not be less than V_{MCG} nor greater than V_R.
V_{MCG}	The Minimum Control speed on the ground is the minimum speed at which the take-off can be continued using only the aerodynamic controls to maintain direction when an outboard engine suddenly becomes inoperative with the remaining three engines at take-off power.
V_R	The Rotation speed is the speed at which the pilot starts to rotate the airplane to obtain the V_2 speed at 35 feet above the runway surface. V_R must not be less than: (1) V_1 (2) $1.05V_{MCA}$ (3) A speed permitting the attainment of V_2 speed at 35 feet above the runway surface. (4) A speed permitting a V_{LOF} of not less than: (a) 1.10 times the four-engine V_{MU} (b) 1.05 times the three-engine V_{MU}
V_{MCA}	The Minimum Control speed in the air is the minimum flight speed at which the airplane is controllable with a maximum allowable bank angle of 5°, when one outboard engine suddenly becomes inoperative with the remaining three operating engines at take-off power.

V_{LOF}	Lift-off speed is the speed at which the airplane first becomes airborne.
V_{MU}	Minimum Unstick speed is the minimum speed at which the airplane can be made to lift off and continue the take-off without displaying any hazardous characteristics.
V_2	Take-off Safety speed is the speed required to permit attainment of the required take-off climb gradient and shall not be less than: (1) V_2 Min (2) The Rotation speed V_R plus the increment in speed attained prior to reaching a height of 35 feet above the take-off surface.
V_2 Min	The Minimum Take-off Safety speed shall not be less than: (1) 1.15 times the Zero-Thrust Stall speed with wing flaps in the take-off position ($1.15V_S$). (2) 1.10 times the Minimum Control speed in the air ($1.1V_{MCA}$).
IAS	Indicated Airspeed is equal to the pitot static airspeed indicator reading, as installed in the airplane, without correction for airspeed indicator system errors but including the sea level standard adiabatic compressible flow correction. (This latter correction is included in the graduation of the airspeed instrument dials.)
CAS	Calibrated Airspeed is equal to the airspeed indicator reading corrected for position and instrument error. (As a result of the sea level adiabatic compressible flow correction to the airspeed instrument dial, CAS is equal to the true airspeed TAS in standard atmosphere at sea level.)
EAS	Equivalent Airspeed is equal to the airspeed indicator reading corrected for position error, instrument error, and for adiabatic compressible flow for the particular altitude. (EAS is equal to CAS at sea level in standard atmosphere).
TAS	True Airspeed of the airplane relative to undisturbed air. TAS = EAS corrected for altitude and temperature.
ISA	International Civil Aviation Organization Standard Atmosphere.
LP RPM	Engine Low Pressure Compressor Revolutions Per Minute or per cent of maximum rated take-off rpm.
ADLS	Automatic Drag Limiting System.

2. Approved Wing Flap Positions

The wing flap positions for the performance information of this Section are as follows:

TAKE-OFF	15°
EN ROUTE	0°
APPROACH	30°
LANDING	45°

3. Demonstrated Crosswind Component

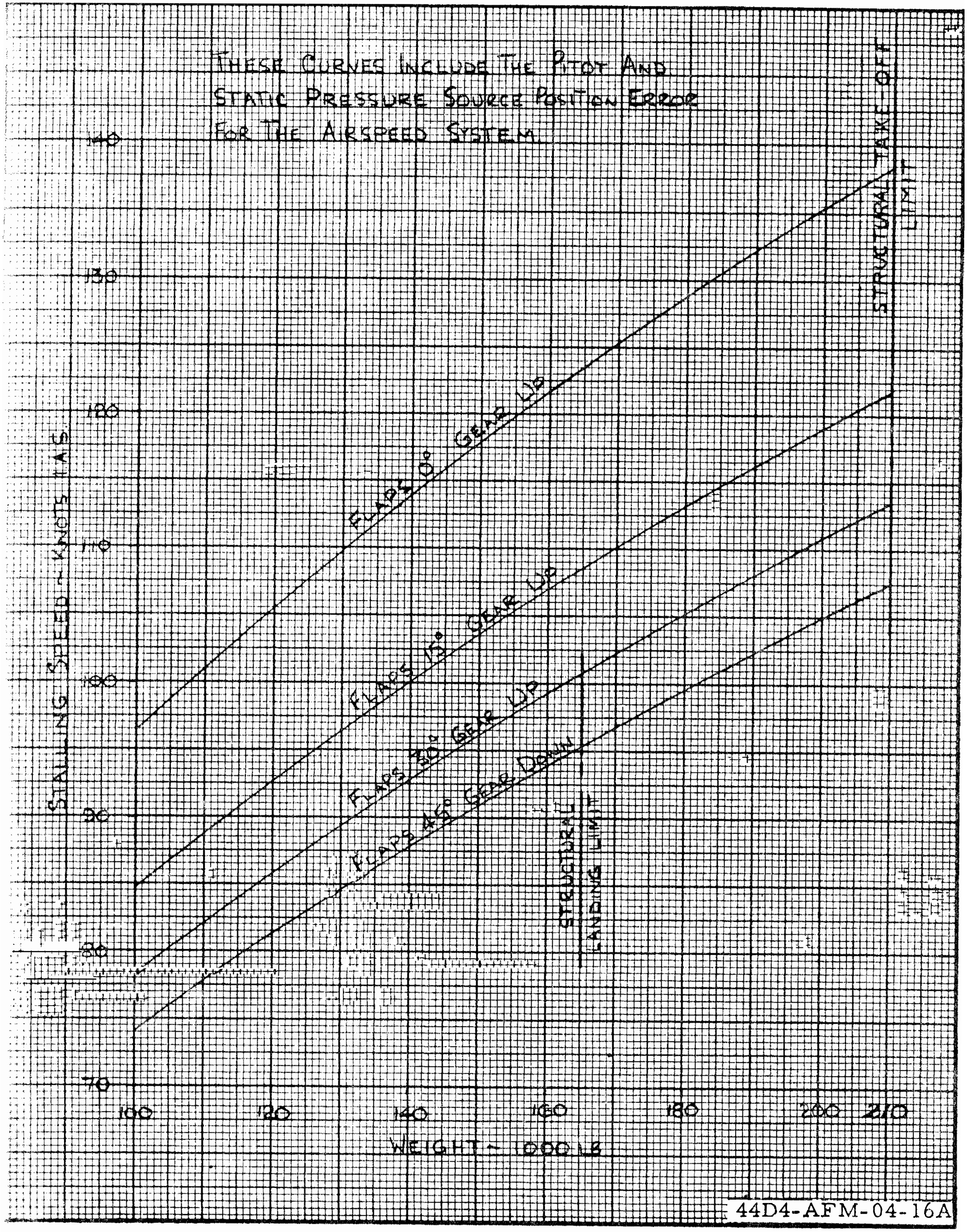
The CL-44D4 has been demonstrated to be satisfactorily controllable during take-off and landing with a crosswind velocity component of 25 knots, measured at a tower height of 50 feet.

This crosswind velocity is the maximum encountered during certification tests but is not considered to be the limiting crosswind velocity for the airplane. A head or tail wind with a corresponding crosswind component greater than this value may not be used in establishing required take-off and landing runway lengths.

3A. Fuel Requirement for Taxiing, Holding and Take-off Run

For all-engine operation, and over the approved range of altitude and temperature, total fuel consumption approximates the following:

Taxiing	40 lb per minute
Holding	40 lb per minute
Take-off run	100 lb (total)



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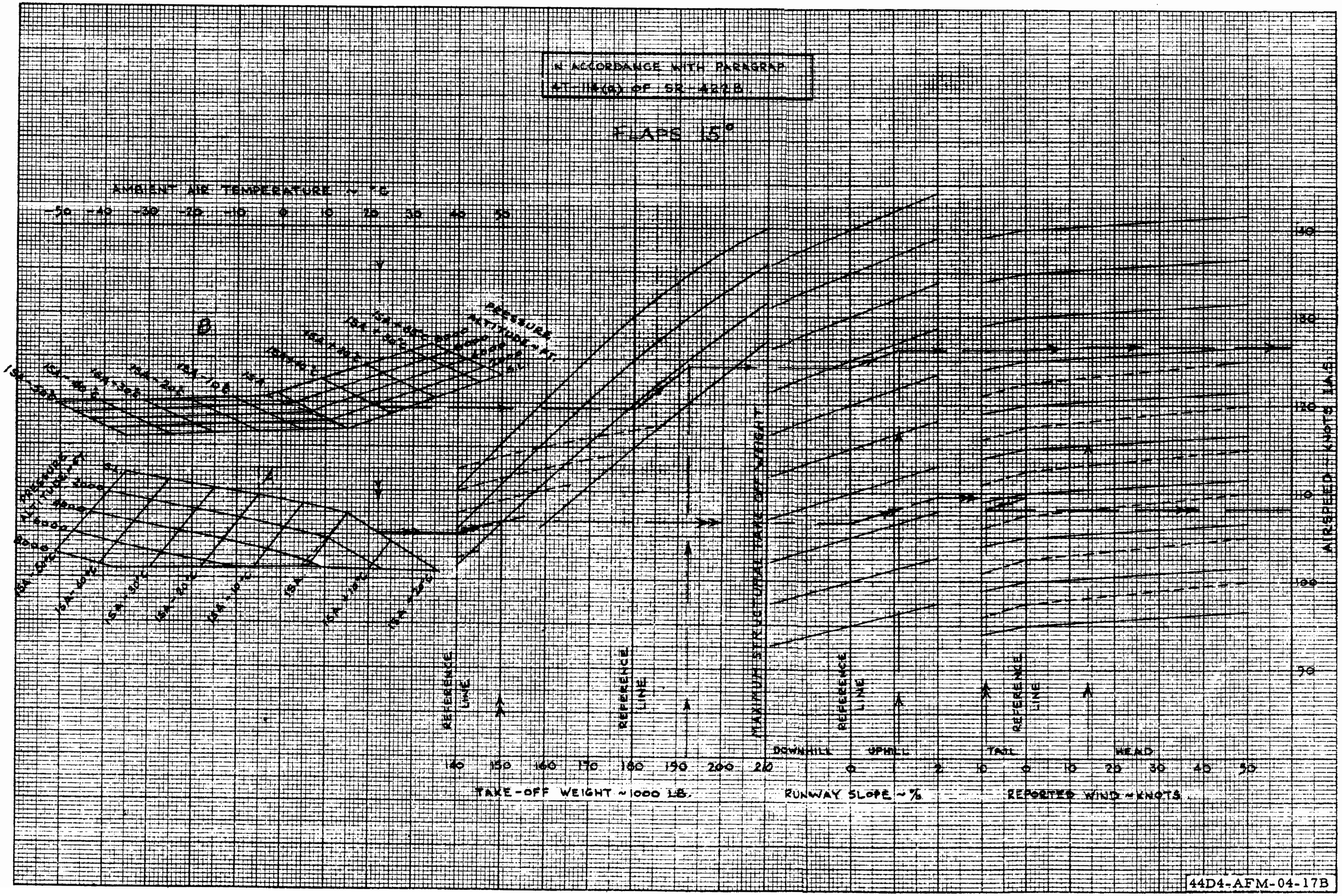
Power-off (Zero Thrust) Stalling Speeds
Figure 1

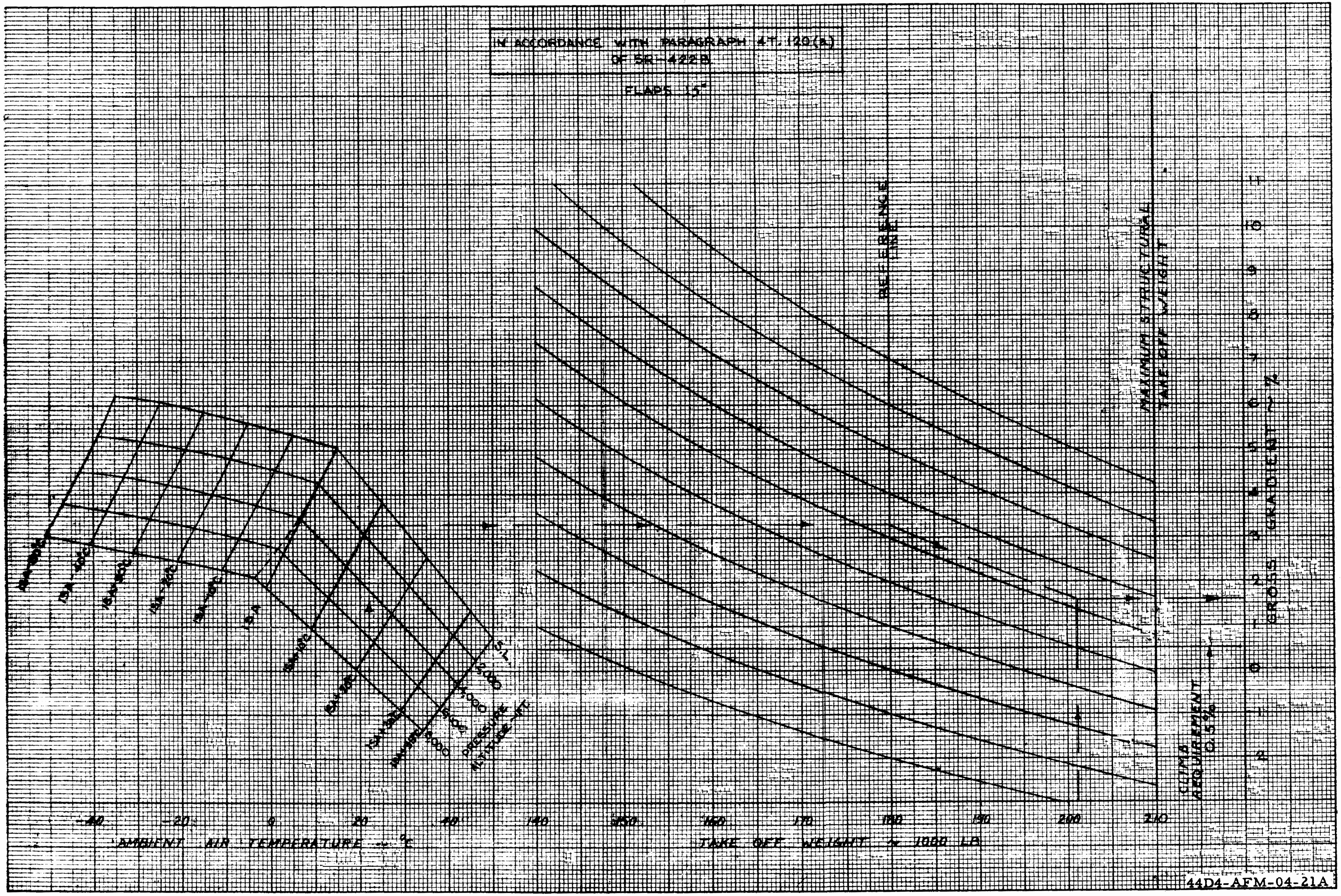
4. Power-off (Zero Thrust) Stalling Speeds

The variation of power-off stalling speeds with weight and wing flap setting is shown in Figure 1.

The stalling speeds have been determined in accordance with Paragraph 4T.112 of SR-422B at the most forward centre of gravity position for the appropriate weight, and for the zero thrust condition.



Critical Engine Failure Recognition Speed (V_1)
Figure 2



Climb Gradient - First Take-off Segment
Figure 6

5. Critical Engine Failure Recognition Speed (V_1)

The critical engine failure recognition speed (V_1), for varying ambient temperatures, take-off weights, runway gradients, pressure altitudes and reported wind components is shown in Figure 2.

Associated Conditions:

Wing flaps	15°
Engines	Operative engines at take-off power
Runway	Hard, dry surface
Landing gear	Retraction initiated upon lift-off

The temperature-altitude grid on the left-hand side of Figure 2 is separated into two parts. The upper part B is applicable to the normal take-off speed regime and the lower part A to the regime where engine-out controllability sets the take-off speed. The solid lines in the weight and wind grids are used in conjunction with part B and the dotted lines with part A.

Example 1 (Single arrows)

This first example illustrates the use of Figure 2 when the take-off speeds fall in the normal take-off regime.

It is found in Example 1 in Sect. 3, Fig. 2 that with an ambient temperature of 22° C (ISA + 10° C), a pressure altitude of 1500 feet, a runway gradient of 1.1% uphill and a reported headwind of 14 knots, the maximum take-off weight is 192,200 pounds. Entering Figure 2 with these conditions and using grid B, since the take-off speeds have been shown in Example 1 in Sect. 3, Fig. 2 to be in the normal take-off regime, gives a critical engine failure recognition speed V_1 of 127 knots.

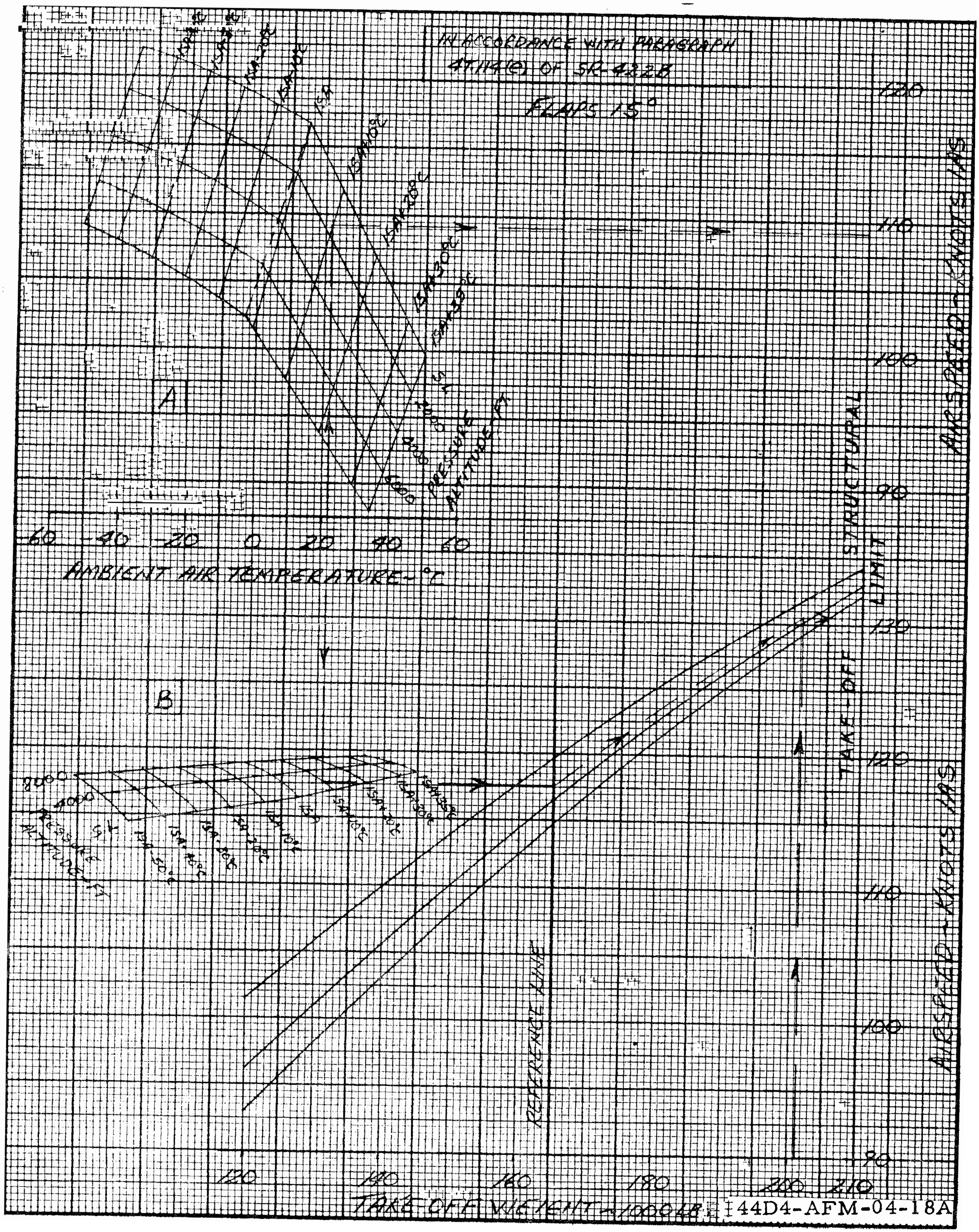
Example 2 (Double arrows)

This second example illustrates the use of Figure 2 when the take-off speeds are set by engine-out controllability.

It is found in Example 2 in Sect. 3, Fig. 2 that at an ambient temperature of 22° C (ISA + 7° C), a pressure altitude of sea level, a runway gradient of 2% uphill and a reported tailwind of 9 knots, the maximum take-off weight is 150,000 pounds. Entering Figure 2 with these conditions and using grid A, since the take-off speeds have been shown in Example 2 in Sec. 3, Fig. 2 to be set by engine-out controllability, gives a critical failure recognition speed V_1 of 108 knots.

NOTES: (1) The wind grid is factored; reported winds may be used directly.

(2) In the event that V_1 would exceed V_R as determined from Figure 3 for the same conditions, V_1 must be made equal to V_R.



Rotation Speed (V_R)
Figure 3

6. Rotation Speed (V_R)

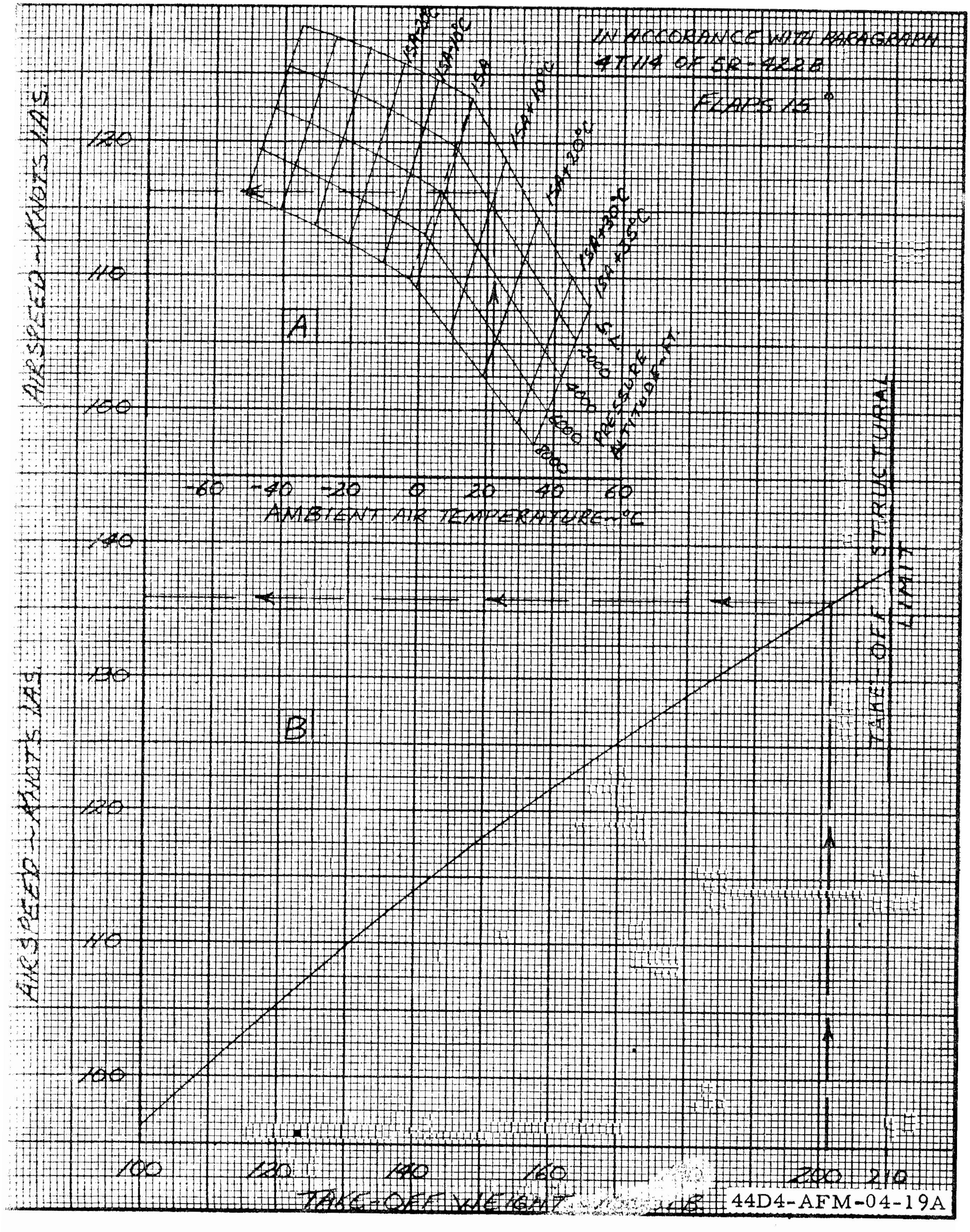
The rotation speed (V_R) shown in Figure 3 is in accordance with Paragraph 4T. 114 (e) of SR-422B, and is the greater of (A) or (B). Curve (A) is the rotation speed set by engine-out control characteristics and will result in a speed at 35 feet greater than 1. 15V_S at light weights. Curve B is the rotation speed that would result in a speed of 1. 15V_S at 35 feet.

Aircraft Configuration:

Landing gear	Extended
Wing flaps	15°
Engine power	Take-off

Example

The example given shows that at a pressure altitude of 1500 feet, an ambient temperature of 22° C (ISA + 10° C), and a take-off weight of 201,200 pounds, curve (A) gives 109 knots IAS and curve (B) gives 131 knots IAS. Therefore, the rotation speed for these conditions is 131 knots IAS.



Take-off Safety Speed (V_2)
Figure 4

7. Take-off Safety Speed (V_2)

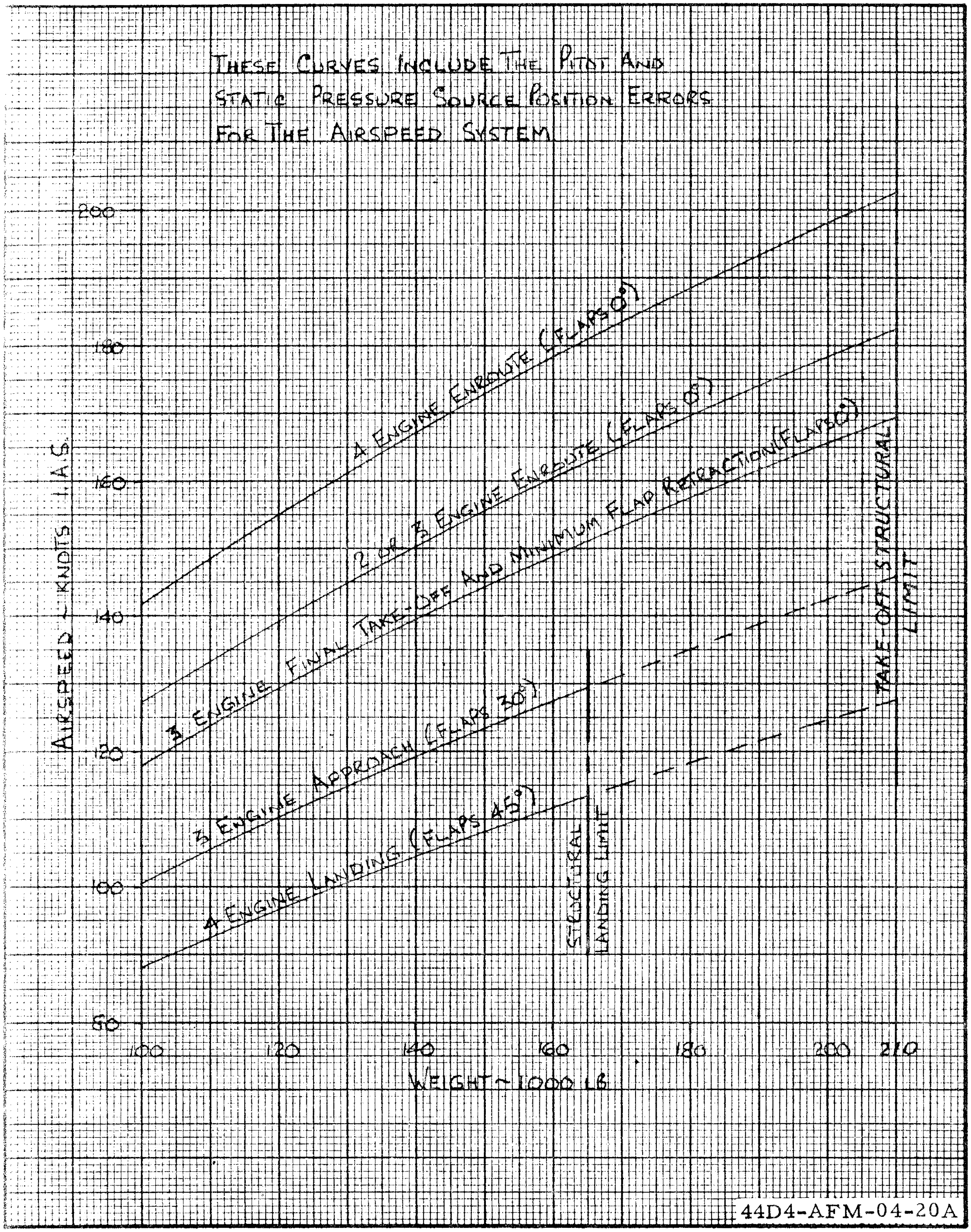
The take-off safety speed (V_2) as shown in Figure 4 is in accordance with Paragraph 4T. 114 (c) of SR-422B and is the greater of (A) or (B). Curve (A) is the minimum take-off safety speed set by engine-out control characteristics during rotation and is independent of aircraft weight. Curve (B) is 1.15V_S and is independent of altitude and temperature.

Aircraft Configuration:

Landing gear	Retracted
Wing flaps	15°
Engine power	Take-off

Example

The example given shows that at a pressure altitude of 1500 feet, an ambient temperature of 22° C (ISA + 10° C), and a take-off weight of 201,200 pounds, curve (A) gives 116 knots IAS and curve (B) gives 136 knots IAS. Therefore, the take-off safety speed for these conditions is 136 knots IAS.



Climb and Minimum Flap Retraction Speeds (Except V_2)

Figure 5

8. Climb and Minimum Flap Retraction Speeds (Except V_2)

The climb speeds for various configurations (except take-off safety speed) and the minimum flap retraction speeds are given in Figure 5.

9. Climb Gradient - First Take-off Segment

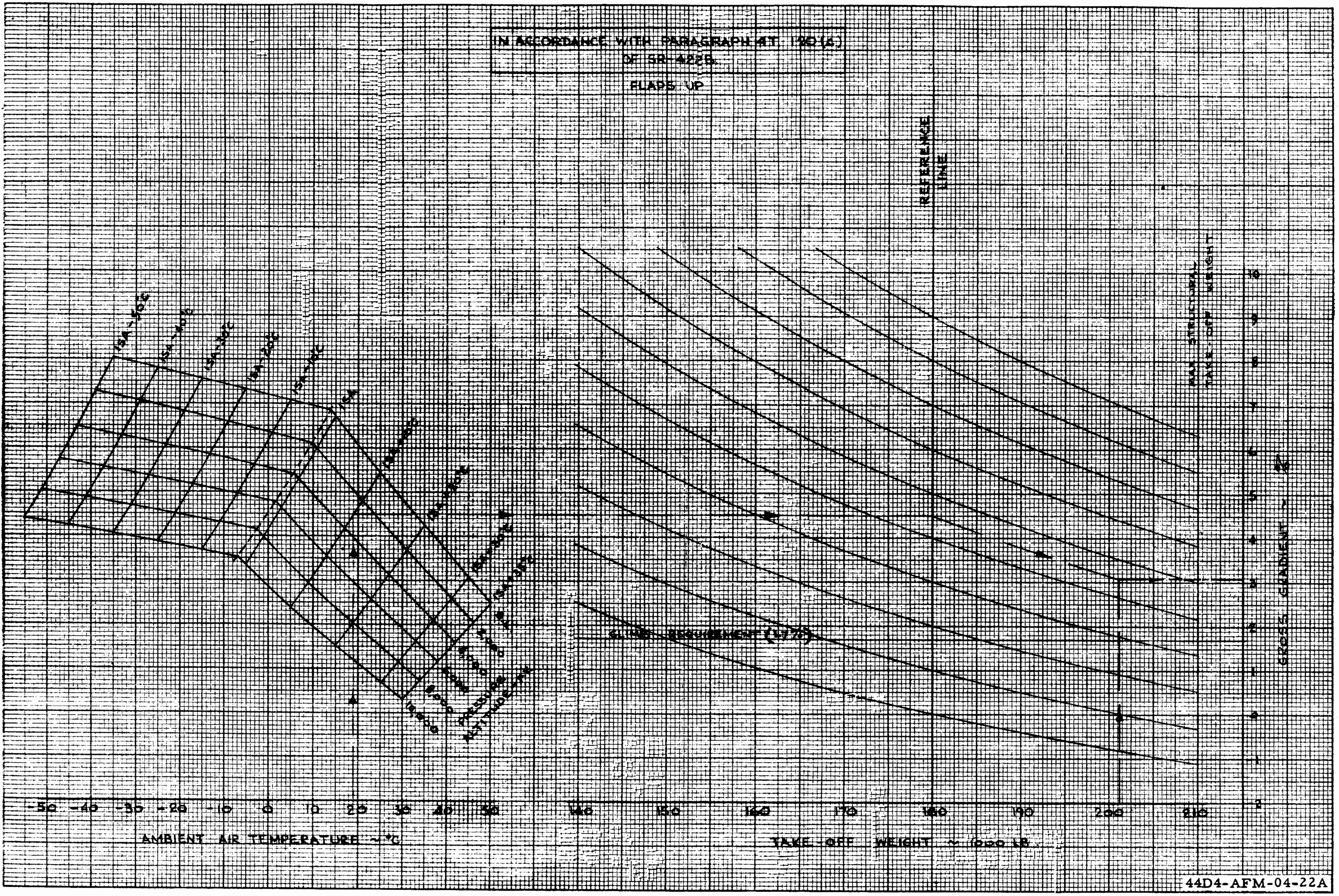
The gross climb gradient in the first take-off segment is shown in Figure 6.

Aircraft Configuration:

Landing gear	Extended
Wing flaps	15°
Engines	One engine inoperative and propeller in ADLS. Operative engines at Take-off Power.
Airspeed	V_{LOF} ($V_{LOF} = V_R + 4$ knots approximately)
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

Example

The example given shows that at an ambient temperature of 22° C (ISA + 10° C) a pressure altitude of 1500 feet and a take-off weight of 201,200 pounds, the gross climb gradient is 1.6%.



Climb Gradient - Final Take-off Segment
Figure 7

10. Climb Gradient - Final Take-off Segment

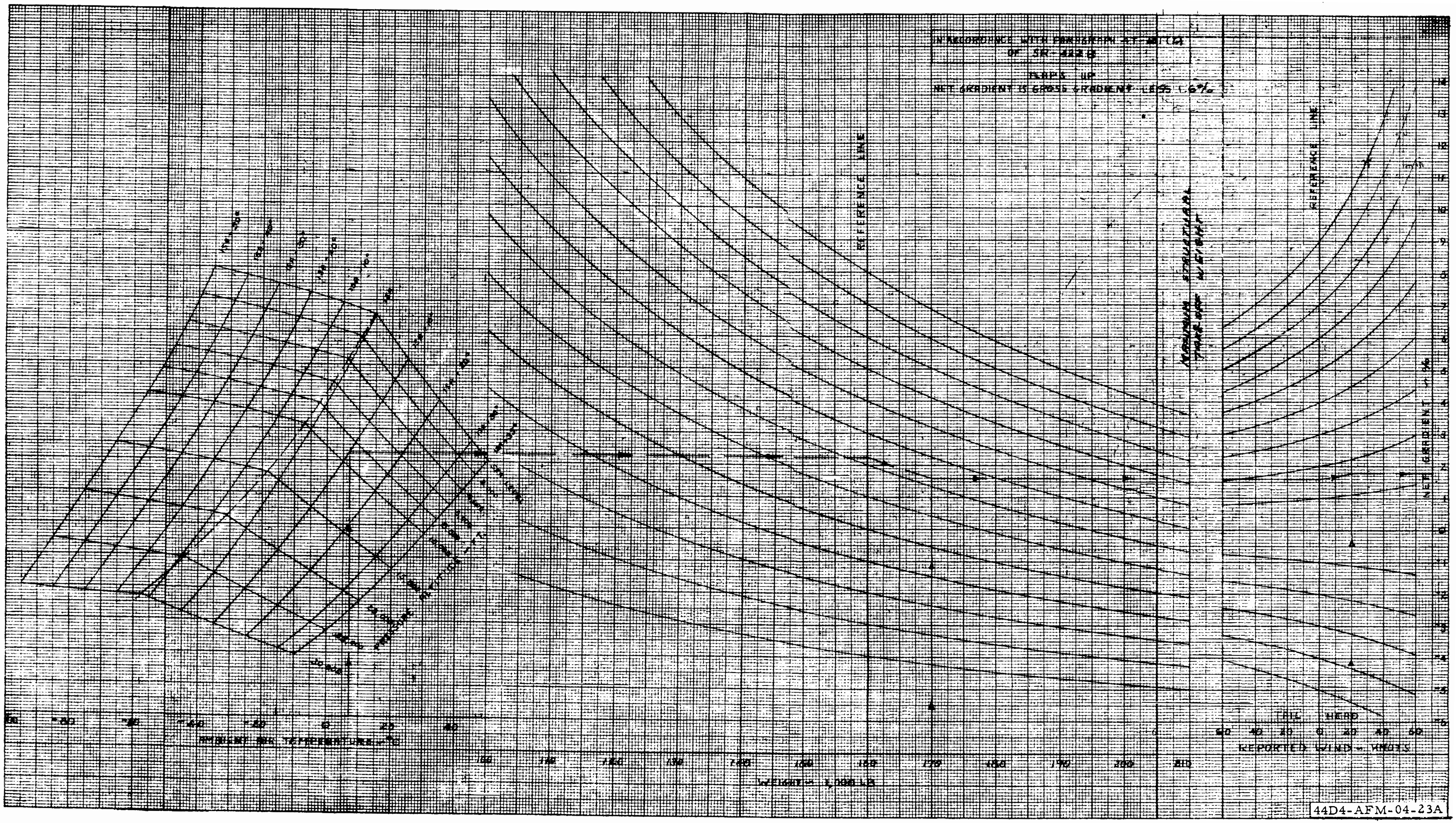
The gross climb gradient in the final take-off segment is shown in Figure 7.

Aircraft Configuration:

Landing gear	Retracted
Wing flaps	Retracted
Engines	One engine inoperative and propeller feathered. Operative engines at Maximum Continuous Power.
Airspeed	$1.25V_S$ (Figure 5)
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

Example

The example given shows that at an ambient temperature of 19°C (ISA + 10°C), a pressure altitude of 3000 feet and a take-off weight of 201,200 pounds, the gross gradient is 3.08%.



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Climb Gradient - Three Engine Enroute
Figure 8

11. Climb Gradient - Three Engine Enroute

The net gradient in the three engine enroute climb configuration is shown in Figure 8.

Aircraft Configuration:

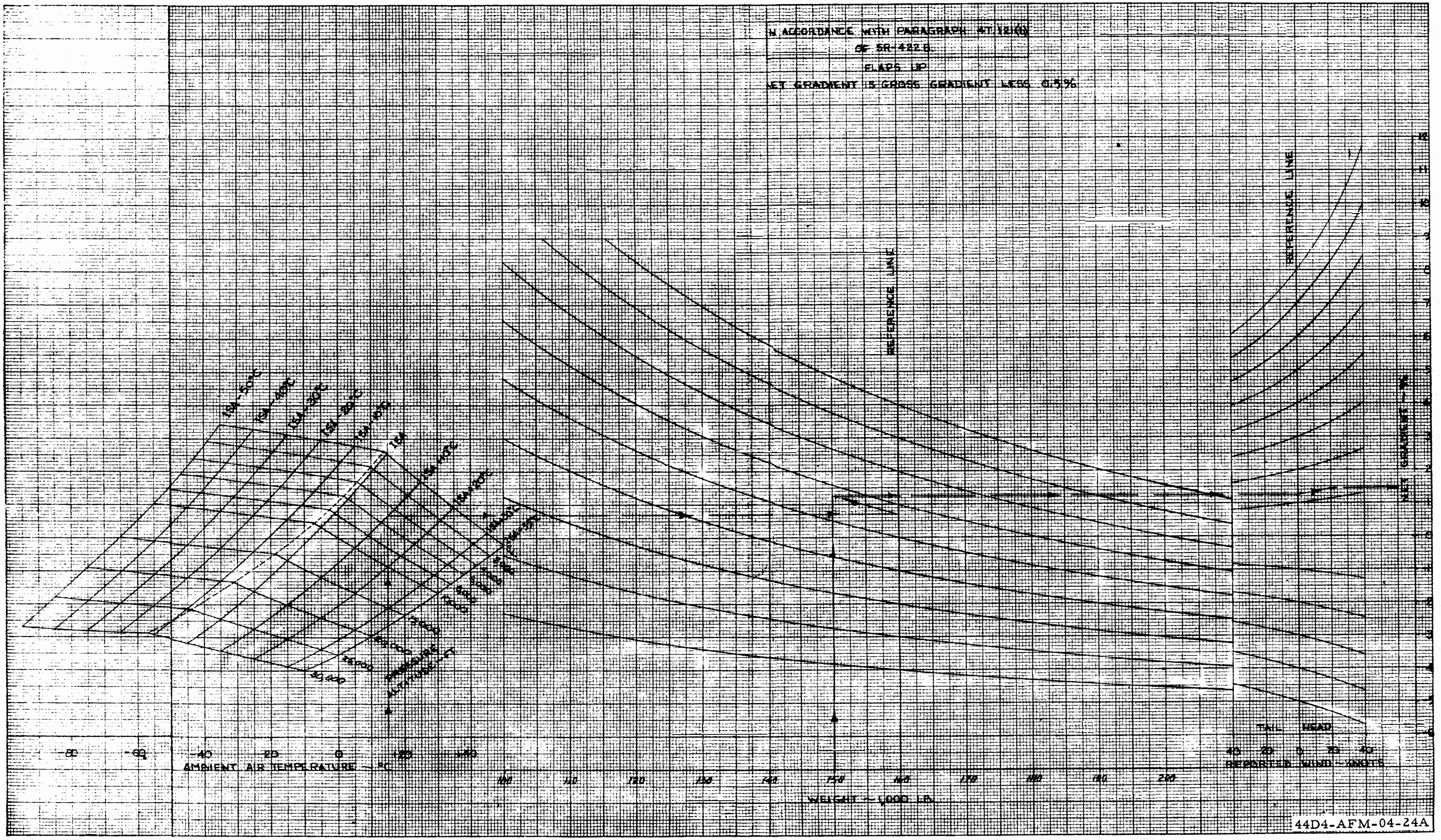
Landing gear	Retracted
Wing flaps	Retracted (See Note 2)
Engines	One engine inoperative and propeller feathered. Operative engines at Maximum Continuous Power.
Airspeed	$1.35V_S$ (Figure 5)
Fuel jettisoning pipes	Retracted
Power plant and airframe anti-icing	Off

Example

The example given shows that at an ambient temperature of 7° C (ISA + 10° C), a pressure altitude of 9000 feet, an aircraft weight of 170,000 pounds, and a reported headwind of 20 knots, the net gradient is 1.80%.

NOTES: (1) When fuel jettisoning pipes are extended, it is estimated that the net gradients of Figure 8 are decreased by 0.3%.

(2) With the wing flaps extended to the Take-off (15°) position, the fuel jettison pipes extended and at the minimum dumping speed of Sect. 1, Fig. 2, the net gradients of Figure 8 are decreased by 1.8%.



Climb Gradient - Two Engine Enroute
Figure 9

12. Climb Gradient - Two Engine Enroute

The net gradient in the two engine enroute climb configuration is shown in Figure 9.

Aircraft Configuration:

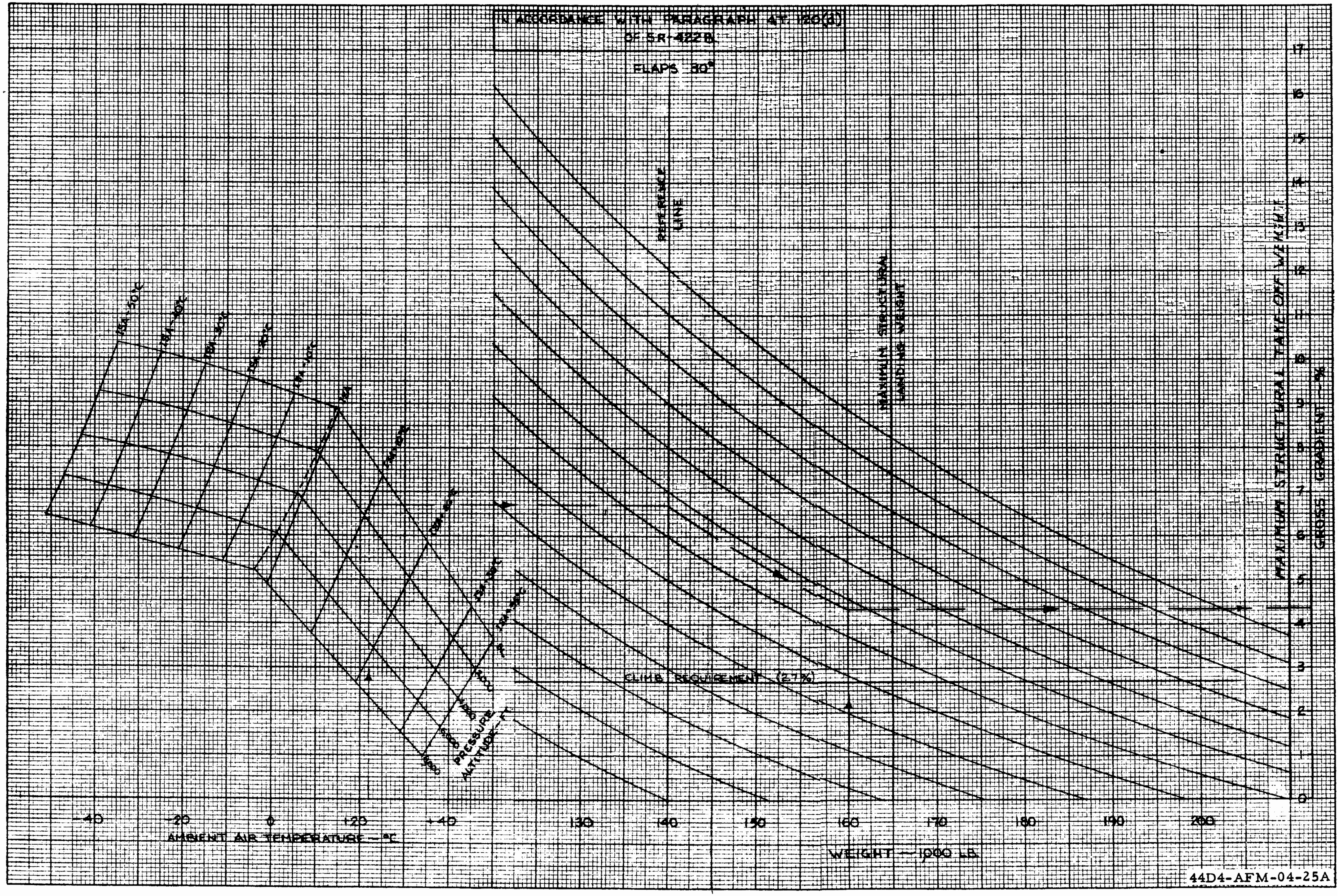
Landing gear	Retracted
Wing flaps	Retracted (See Note 2)
Engines	Two engines inoperative and propellers feathered. Operative engines at Maximum Continuous Power.
Airspeed	1.35V_S (Figure 5)
Fuel jettisoning pipes	Retracted
Power plant and airframe anti-icing	Off

Example

The example given shows that at an ambient temperature of 15° C (ISA + 10° C), a pressure altitude of 5000 feet, an aircraft weight of 150,000 pounds, and a reported headwind of 20 knots, the net gradient is 1.45%.

NOTES: (1) When fuel jettisoning pipes are extended, it is estimated that the net gradients of Figure 9 are decreased by 0.3%.

(2) With the wing flaps extended to the Take-off (15°) position, the fuel jettison pipes extended and at the minimum dumping speed of Sect. 1, Fig. 2, the net gradients of Figure 9 are decreased by 1.3%.



Climb Gradient - Approach
Figure 10

13. Climb Gradient - Approach

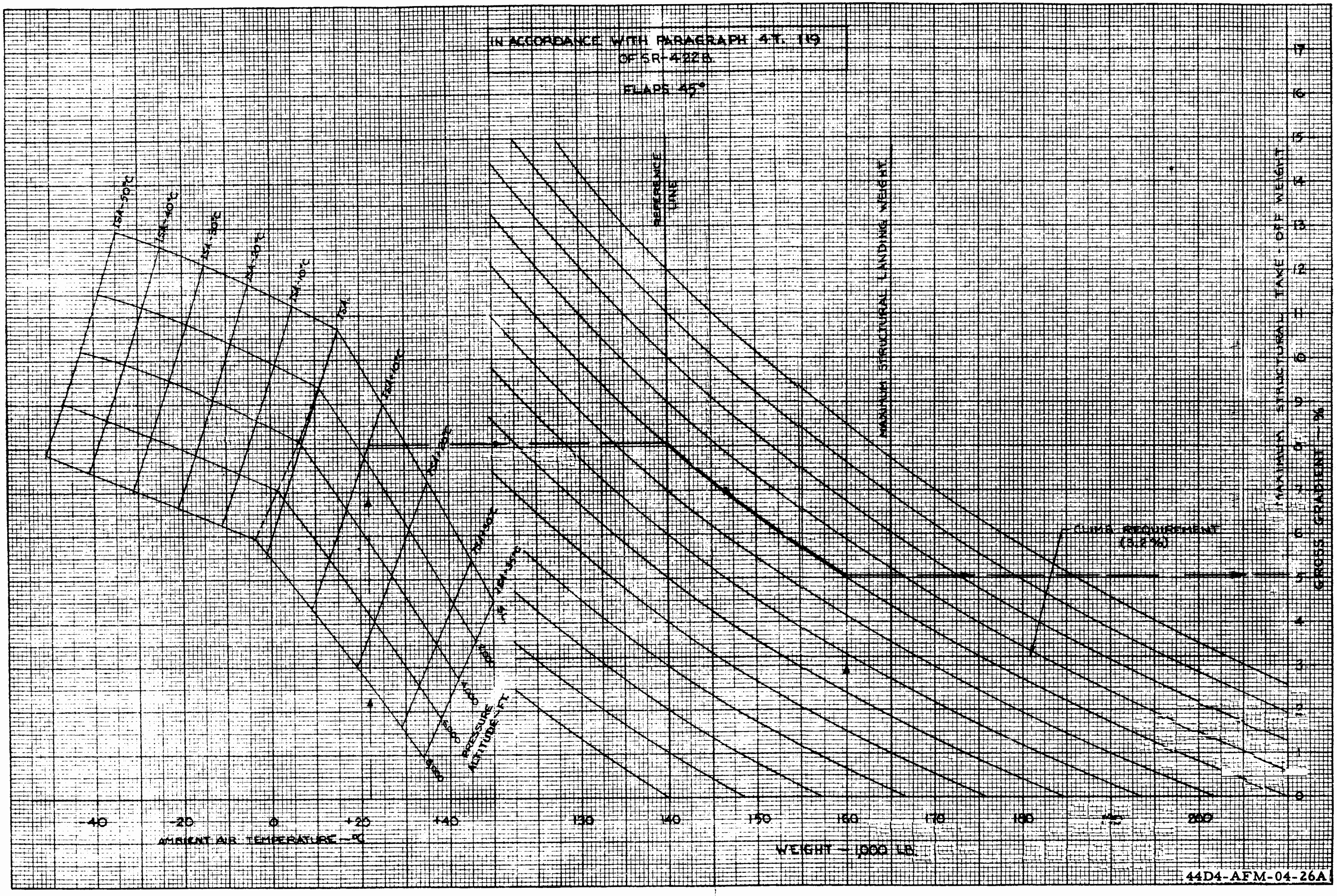
The gross gradient in the approach climb configuration is shown in Figure 10.

Aircraft Configuration:

Landing gear	Retracted
Wing flaps	30°
Engines	One engine inoperative and the propeller feathered. Operative engines at Take-off Power
Airspeed	1.3V_S (Figure 5)
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

Example

The example given shows that at an ambient temperature of 22° C (ISA + 10° C) a pressure altitude of 1500 feet and an aircraft weight of 160,000 pounds, the gross gradient is 4.35%.



Climb Gradient - Landing
Figure 11

14. Climb Gradient - Landing

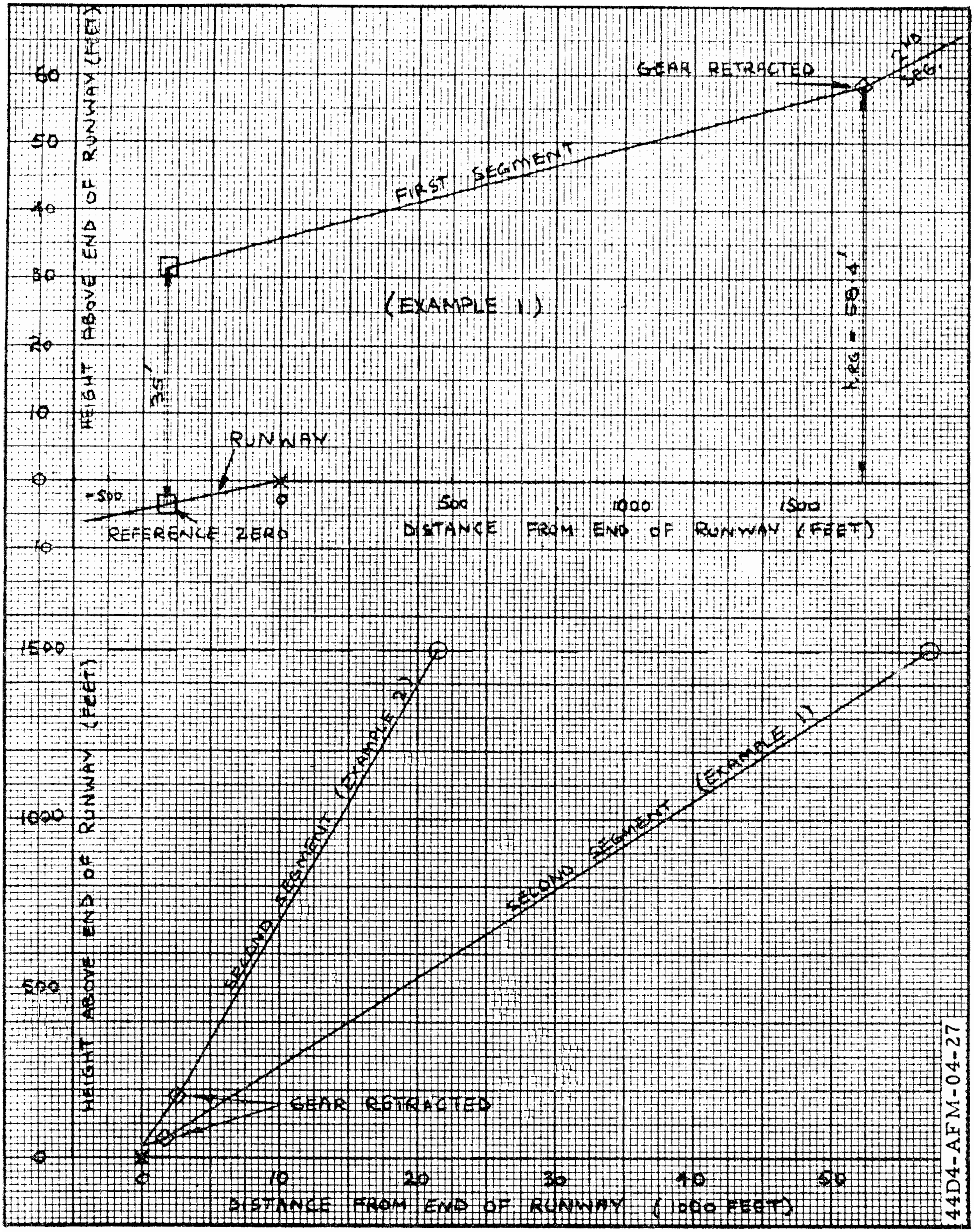
The gross gradient in the landing configuration is shown in Figure 11.

Aircraft Configuration:

Landing gear	Extended
Wing flaps	45°
Engines	All engines at Take-off Power
Airspeed	1.2V_S(Figure 5)
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

Example

The example given shows that at an ambient temperature of 22° C (ISA + 10° C a pressure altitude of 1500 feet and an aircraft weight of 160,000 pounds, the gross gradient is 5.05%.



Take-off Net Flight Path Examples
Figure 12

15. Net Take-off Flight Path

A. Introduction

The information provided in this section makes possible the construction of a complete net take-off flight path to a height of 1500 feet above the airport. It is assumed that one power unit is inoperative throughout, and that power failure has occurred at the speed V_1.

The graphs used in determining take-off flight path have been constructed so that the fuel consumed in climb has not been allowed for and therefore, the flight path based on the take-off weight will be slightly conservative.

Two complete examples are given in the text and illustrated in Figure 12. While the examples given assume a weight and so determine a flight path, it is also possible to assume a range of weights with other conditions remaining constant and to calculate the take-off distance and net flight path. Then, knowing the distance of the obstruction from the start of take-off and its height, the limiting weight can be found graphically by plotting the clearance against the weight and reading off the weight for the required clearance, between the flight path and the obstacle, of 35 feet.

B. Presentation

The basic take-off flight path information is presented in Figures 13 to 17 inclusive. A number of terms relating to the take-off flight path presentation are listed below.

(1) Reference Zero

The zero to which the coordinates of various points in the take-off flight path are referred is defined by (a) a vertical datum which passe through the 35-foot height point at the end of the take-off distance required, and (b) a horizontal datum which is 35 feet below this point.

(2) First Segment

This segment extends from reference zero to the point at which the landing gear is fully retracted.

(3) Second Segment

This segment extends from the end of the first segment up to 1500 feet. Take-off and climb to this altitude can always be achieved within the five-minute take-off power limitation.

C. Procedures

The take-off flight path is based on the following procedures:

Failure of an engine is assumed to occur during the take-off at the critical speed V_1. Landing gear is selected up three seonds after lift-off. The propeller on the inoperative engine is feathered as soon as possible after lift-off. The climbing speed to the height of 1500 feet is V_2.

Example 1 (Single Arrows)

This first example gives the method of calculating the take-off flight path and uses the same conditions as Example 1 in Sect. 3, Fig. 2.

Using the same conditions as in Example 1 in Sect. 3, Fig. 2 (i.e., an ambient temperature of 22°C (ISA + 10°C), a pressure altitude of 1500 feet, a runway gradient of 1.1% uphill, a reported headwind of 14 knots and a take-off weight of 192,200 pounds) it is found that V_1 from Figure 2 is less than V_R from Figure 4-3. Therefore Figure 13 (Take-off Field Length when V_1 is less than V_R) is used to determine the take-off distance to reference zero.

Entering Figure 13 with the appropriate conditions and using grid B, since the take-off speeds have been shown in Example 1 in Sect. 3, Fig. 2 to be in the normal take-off regime, gives a take-off distance to reference zero of 7100 feet. This distance is less than the available runway length of 7430 feet (Example 1, Sect. 3, Fig. 2) and reference zero is therefore 330 feet back from the end of the runway as shown in the upper graph on Figure 12. Since the runway has an uphill slope of 1.1%, reference zero is also .011 x 330 = 3.6 feet below the end of the runway.

Entering Figures 15 and 16 with the appropriate conditions, and using grid B as before, it is found that the net height above, and the horizontal distance from, reference zero are 62 feet and 2020 feet respectively. That is 62 minus 3.6 = 58.4 feet above and 2020 minus 330 = 1690 feet from the end of the runway. This is shown as the first segment in Example 1 on Figure 12 and the height is called h_{RG} or height at gear retraction. A presentation of this accuracy would normally only be required for checking clearance of close-in obstacles.

The second segment flight path from the end of the first segment to 1,500 feet is determined by calculation. It is assumed that the standard temperature lapse rate applies and that the ambient temperature will remain at ISA + 10°C. The second segment net climb gradient is determined from Fig. 4-17, using the appropriate conditions except that a mean altitude must be used. In selecting the mean altitude for the purpose of showing that existing obstacles are not critical with respect to a conservative flight path it is acceptable to use the mean altitude between the end of the first segment and 1,500 feet; for more accurate analysis of obstacle clearance in the second segment, however, the mean altitude between the end of the first segment and the height of the obstacle should be used. For the 1,500-foot case, the mean altitude is calculated as follows:

$$h \text{ mean} = hp + \frac{1500 + h_{RG}}{2}$$

where hp is the airport pressure altitude

For this example

$$h \text{ mean} = 1500 + \frac{1500 + 58.4}{2} = 2279 \text{ feet}$$

The second segment net climb gradient using Figure 17 is found to be 2.6%.

The distance from the end of the first segment to completion of the second segment is calculated as follows:

$$\text{Distance} = \frac{1500 - h_{RG}}{\text{net gradient}}$$

$$= \frac{1500 - 58.4}{.026} = \frac{1441.6}{.026}$$

$$= 55{,}450 \text{ feet}$$

The total distance from the end of the runway to reaching a height of 1500 feet above the end of the runway is therefore 1690 + 55,450 = 57,140 feet. The complete flight path is plotted in the lower graph on Figure 12.

Example 2 (Double Arrows)

This second example will be worked out with the minimum of explanation using the conditions for the second example in Sect. 3, Fig. 2 which are as follows:

Ambient temperature	22°C (ISA + 7°)
Pressure altitude	Sea level
Reported tailwind	9 knots
Runway slope	2% uphill

Runway length	5100 feet
Take-off weight	150,000 pounds

V_1 is less than V_R for these conditions, and, entering Figure 13 and using grid A, the take-off distance to reference zero is 5050 feet. This can be taken as the end of runway in this case.

From Figures 15 and 16, the first segment height above and horizontal distance from reference zero to gear retraction are 181 feet and 2570 feet respectively

The mean altitude

$$h \text{ mean} = 0 + \frac{1500 + 181}{2}$$

$$= 840 \text{ feet}$$

Assuming standard temperature lapse rate, enter Figure 17 at 840 feet and ISA + 7°C and the second segment net gradient is 7%.

The distance from gear retracted to 1500 feet is

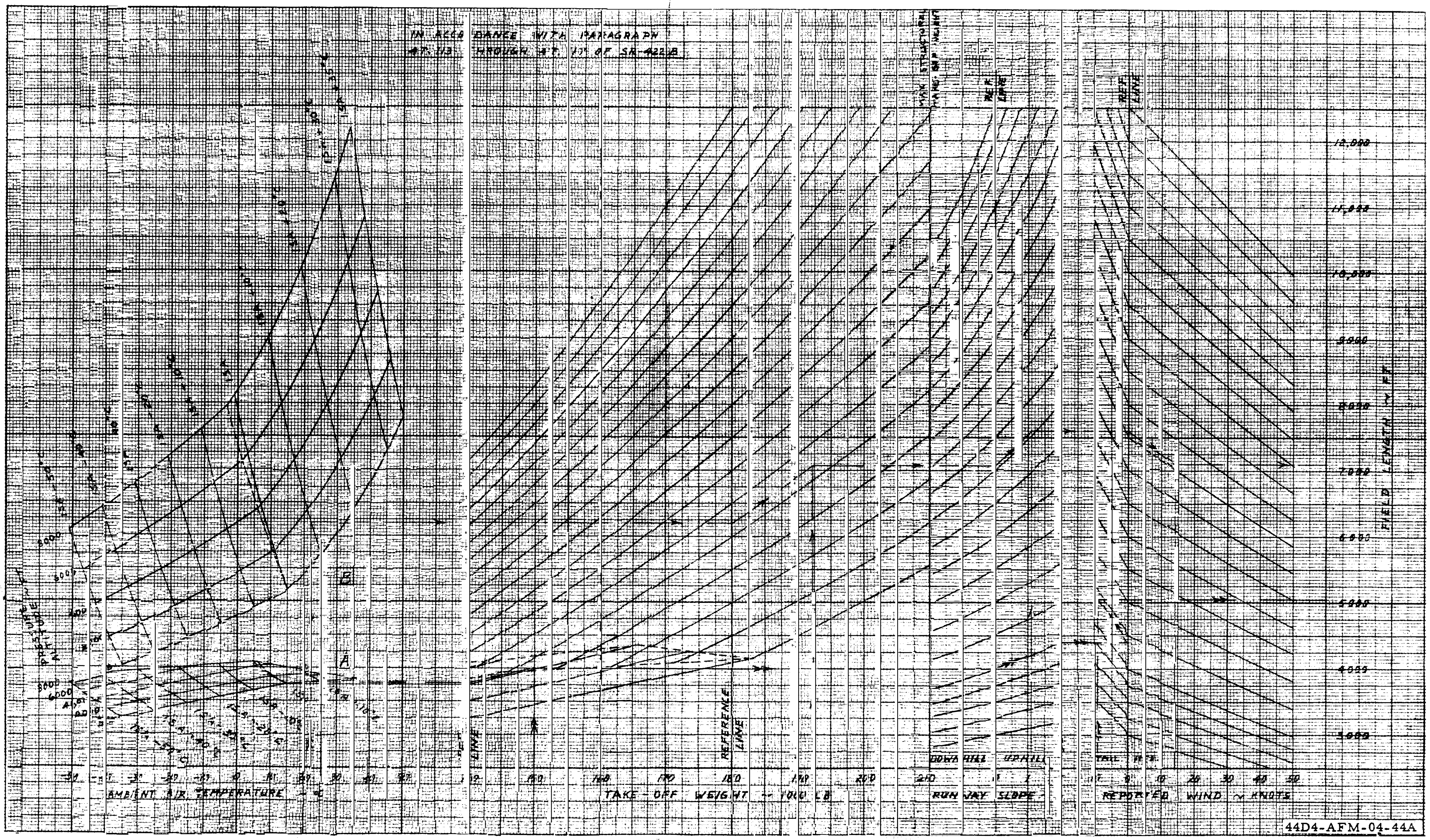
$$\frac{1500 - 181}{.07} = \frac{1319}{.07}$$

$$= 18{,}840 \text{ feet}$$

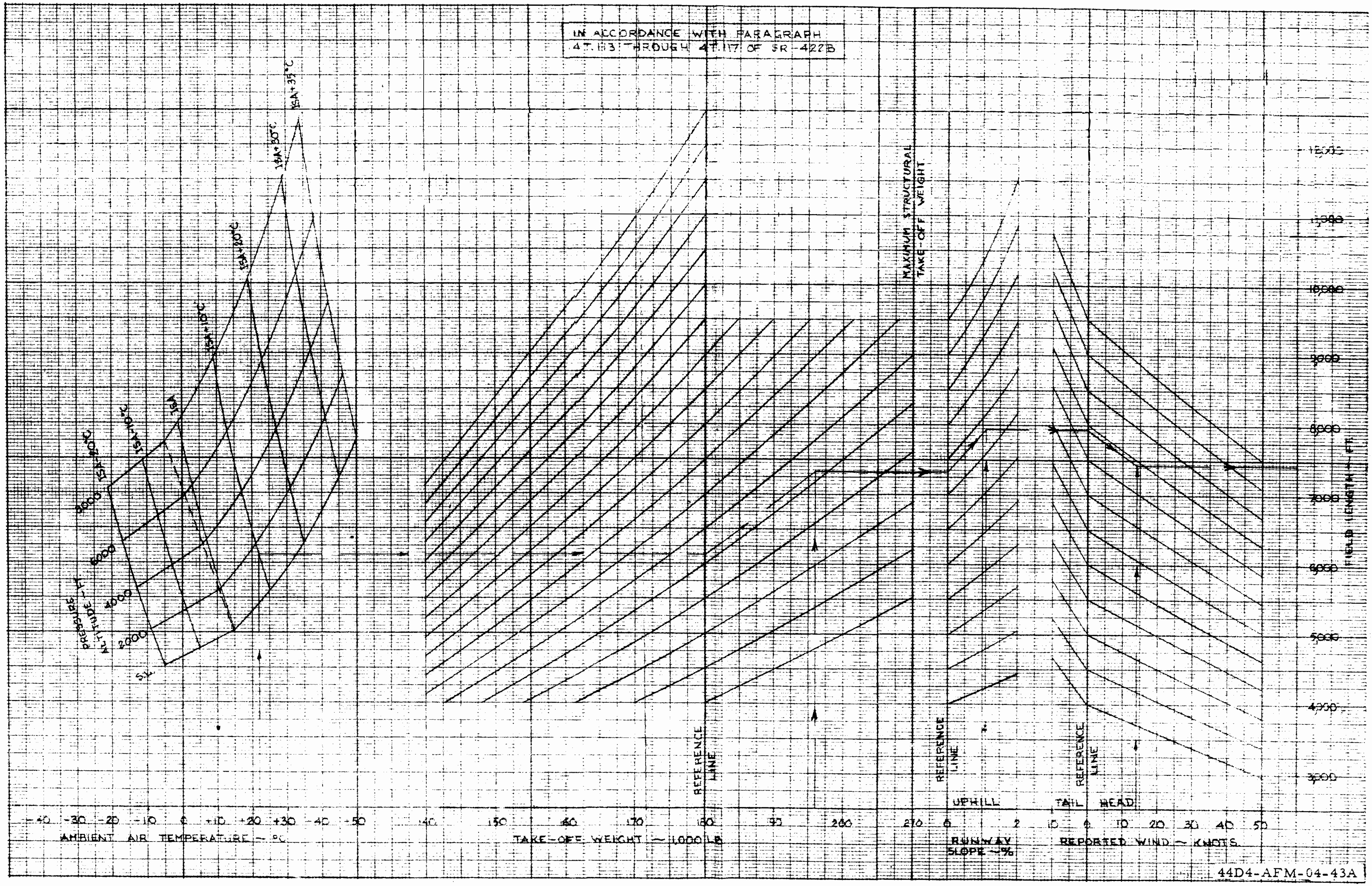
Total distance to 1500 feet from end of runway = 2,570 + 18,840 = 21,410 feet. The complete flight path is plotted in the lower graph on Figure 12.

NOTES: (1) The wind grid is factored; reported winds may be used directly.

(2) When $V_1 = V_R$, use Figure 14 to obtain the take-off distance to reference zero. The example given on Figure 14 shows that at an ambient temperature of 22°C (ISA + 10°C) and an altitude of 1500 feet, and for a take-off weight of 196,000 pounds, a runway slope of 1.1% uphill and a reported headwind of 14 knots, the field length is 7430 feet.

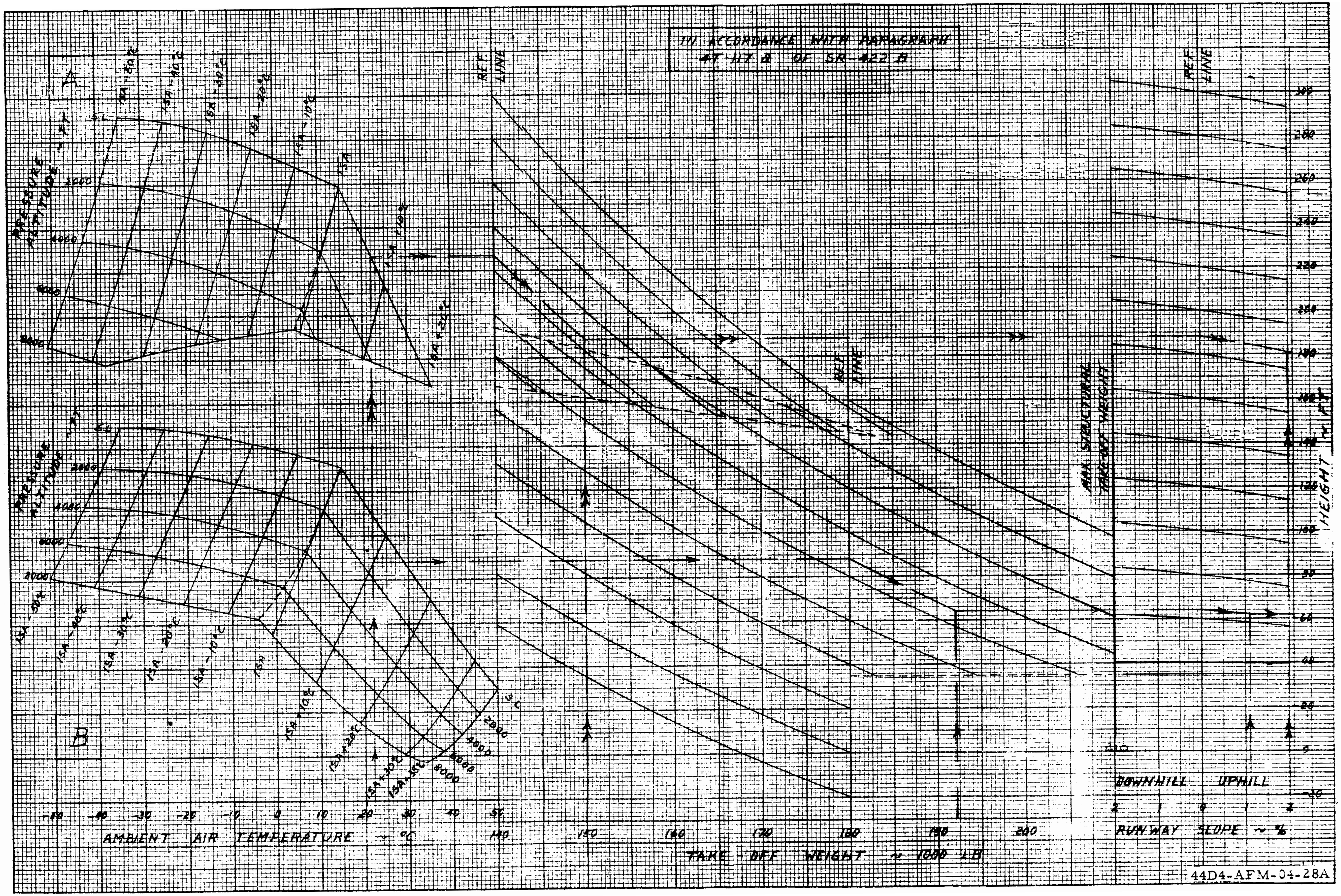


Take-off Field Length when V_1 is Less than V_R
Figure 13

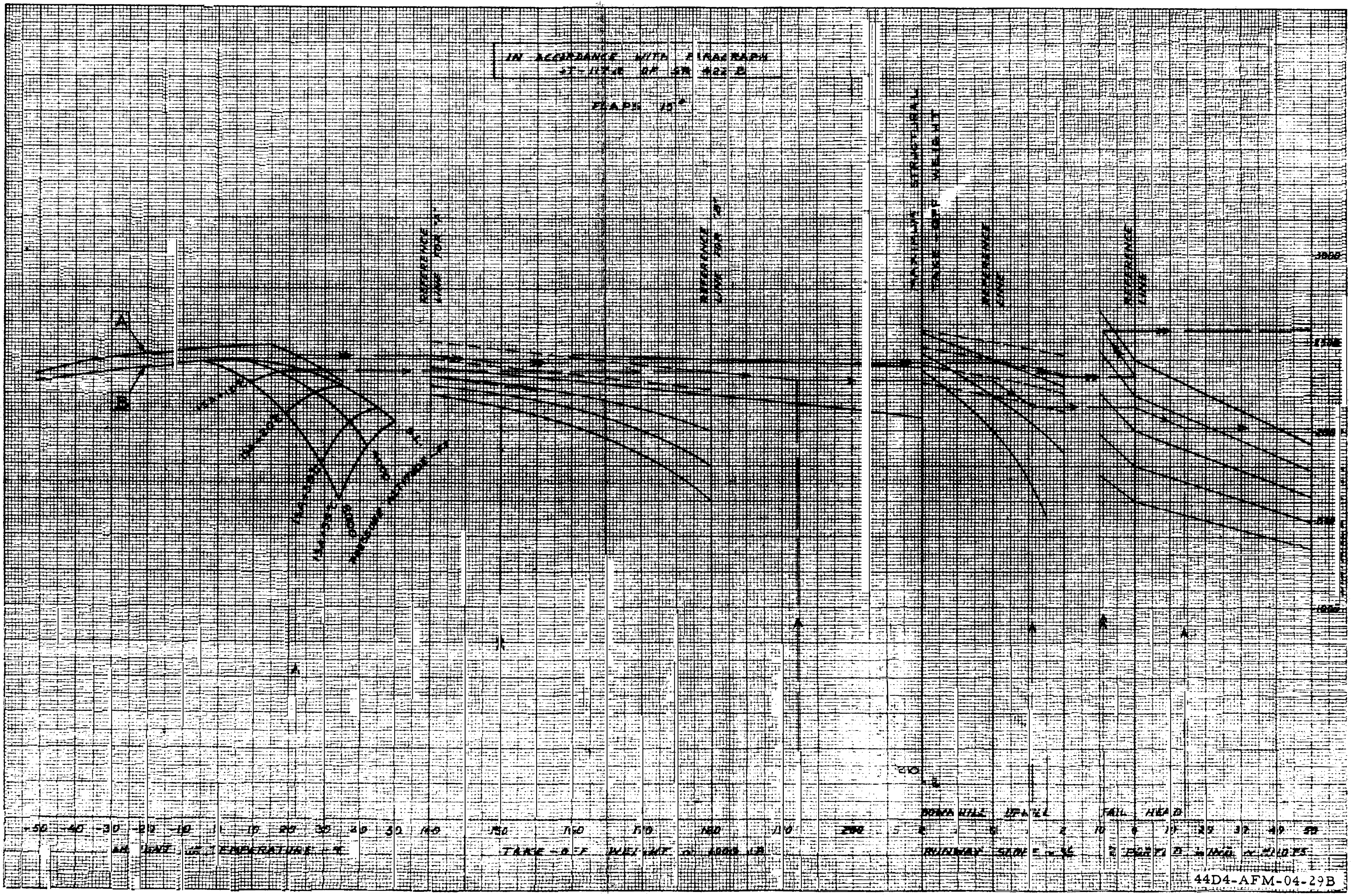


Take-off Field Length when V_1 Equals V_R

Figure 14



Net Height above Reference Zero at Completion of Gear Retraction
Figure 15



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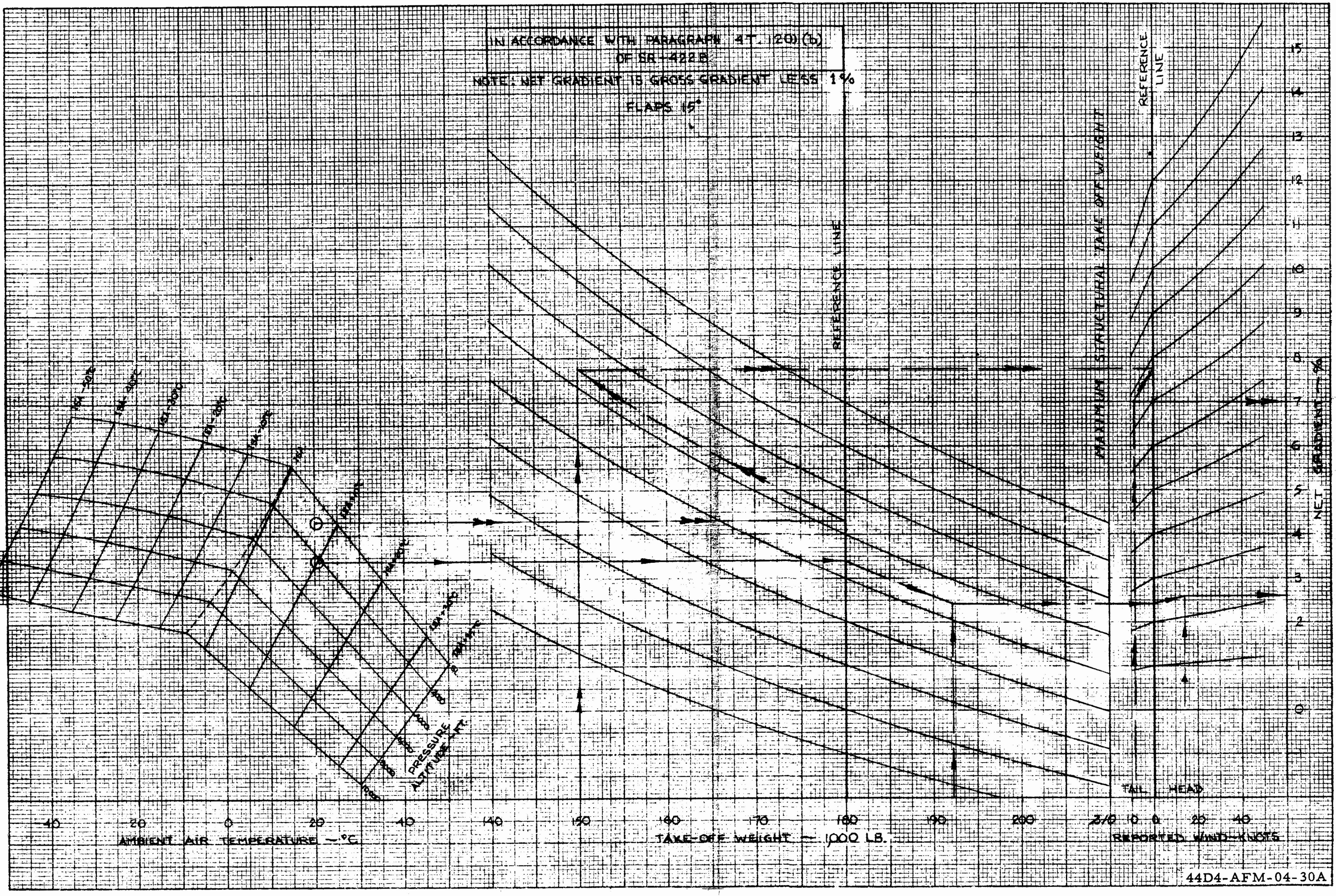
Horizontal Distance from Reference Zero to Completion of Gear Retraction
Figure 16



Climb Gradient - Second Take-off Segment
Figure 17

16. Climb Gradient - Second Take-off Segment

The net climb gradient in the second take-off segment is shown in Figure 17.

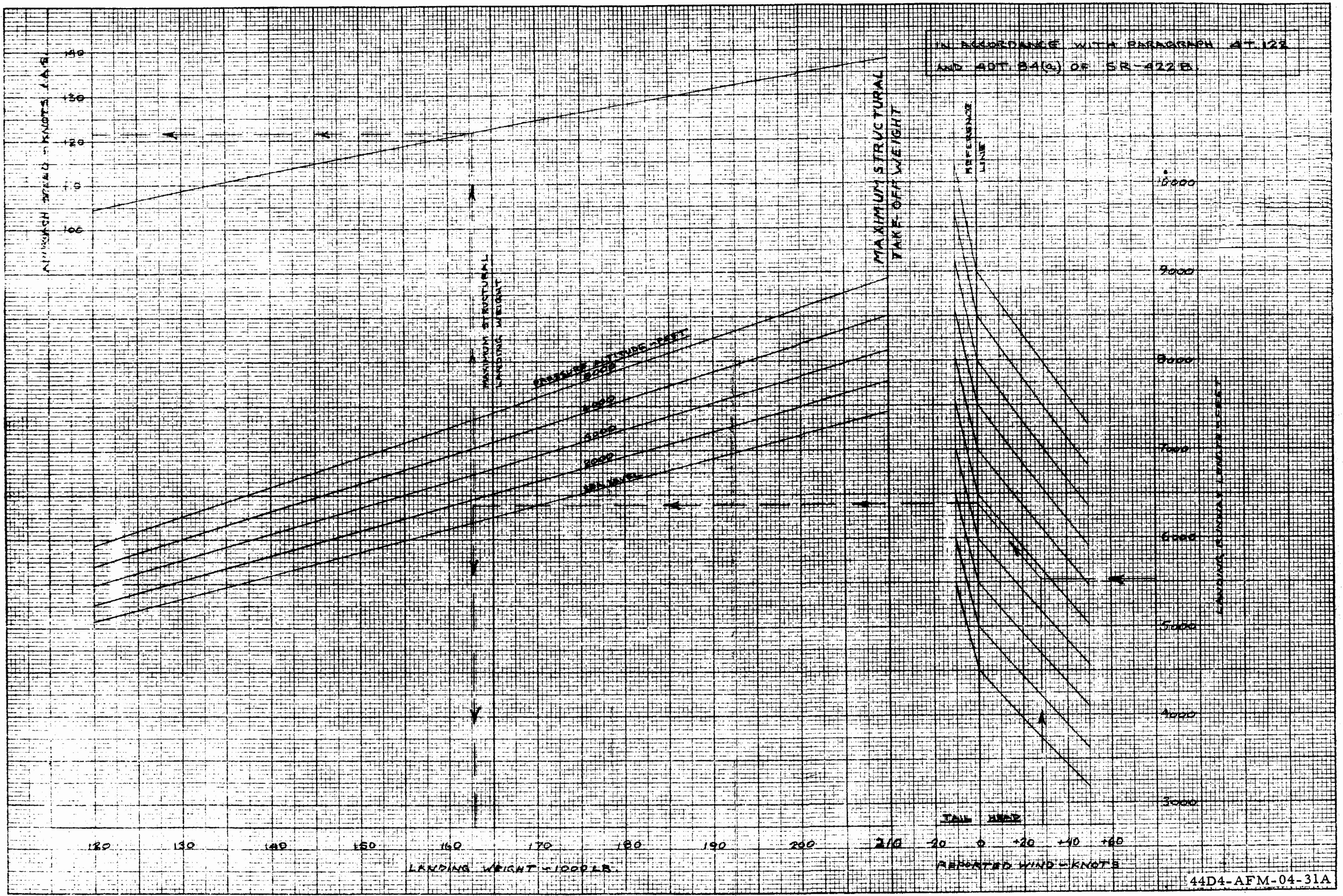
Aircraft Configuration:

Landing gear	Retracted
Wing flaps	15°
Engines	One engine inoperative and propeller feathered. Operative engines at Take-off Power (100% LP rpm).
Airspeed	V_2 (Figure 4)
Power plant and airframe anti-icing	Off
Pressurization	Ambient altitude

Example

The example given shows that at an ambient temperature of 22° C (ISA + 10°C) a pressure altitude of 1500 feet, a take-off weight of 201,200 pounds, and a reported headwind of 14 knots, the net climb gradient is 2.1%.

NOTE: The wind grid is factored; reported winds may be used directly.



Maximum Landing Weight Permitted by Landing Runway Length at Intended Destination
Figure 18

17. Maximum Landing Weight Permitted by Landing Runway Length at Intended Destination

The landing runway length for intended destinations is shown in Figure 18.

The landing runway length is defined as the actual landing distance from 50 feet divided by 0.6.

Associated Conditions:

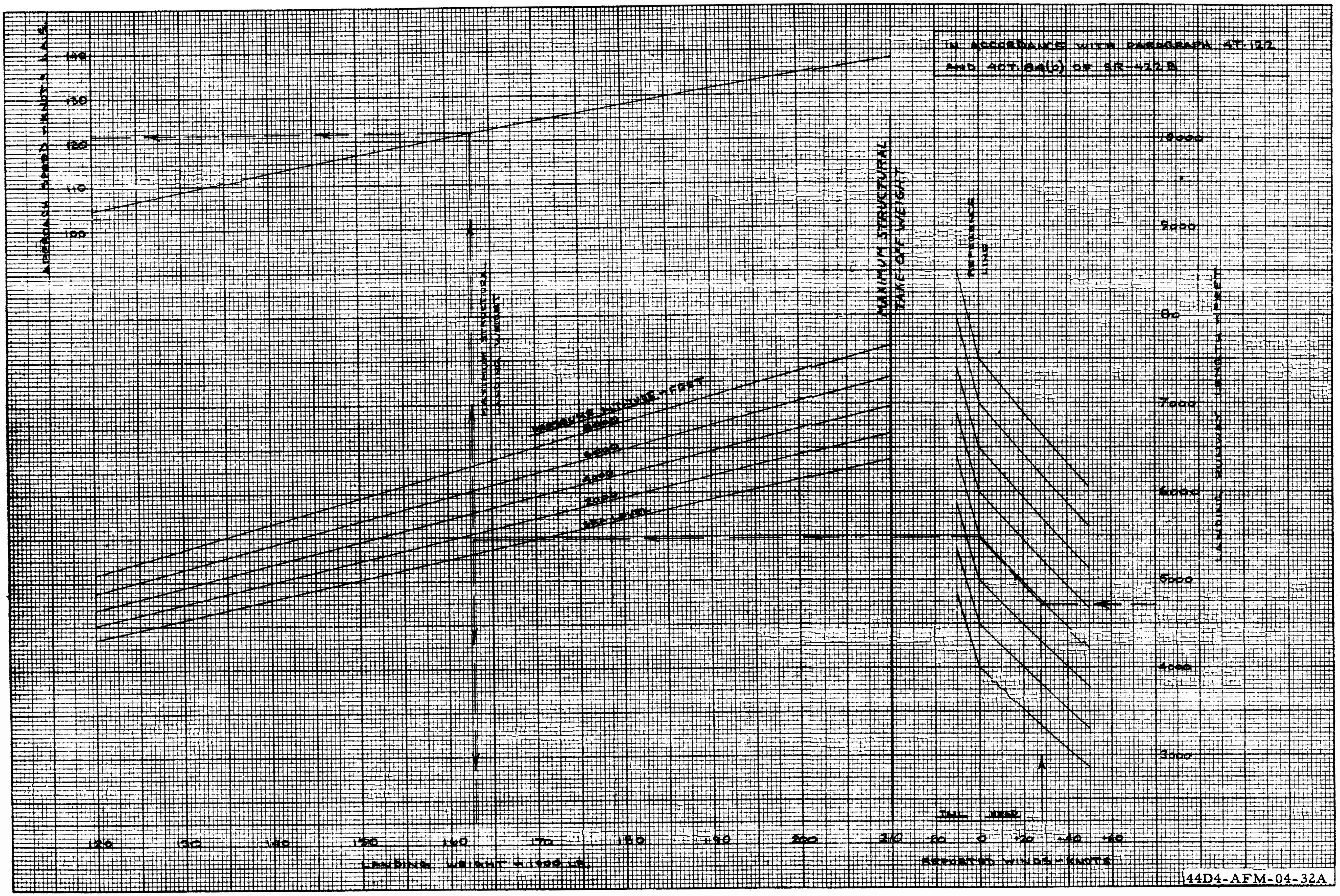
Wing flaps	45°
Landing gear	Extended
Runway	Hard, dry surface
Anti-skid units	Operative
Approach speed	As shown on Figure 18.

Example

The example given shows that with a landing runway length of 5530 feet, a reported headwind of 28 knots and an airport altitude of 1500 feet, the maximum landing weight is 162,800 pounds. The corresponding approach speed is 122 knots IAS.

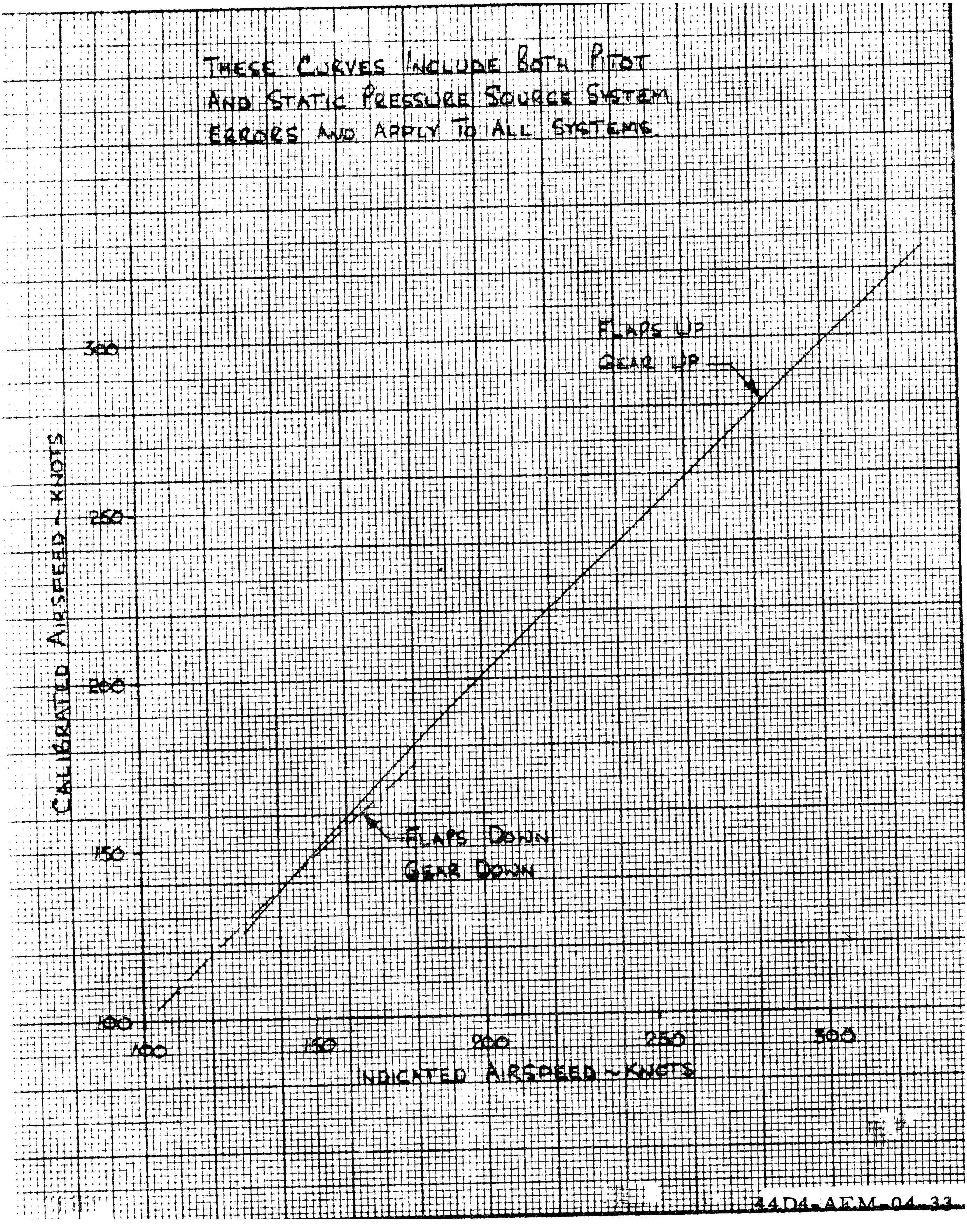
NOTES: (1) The wind correction grid is factored; reported winds may be used directly.

(2) For landing weights below 120,000 pounds, use approach speed and landing runway length for 120,000 pounds.

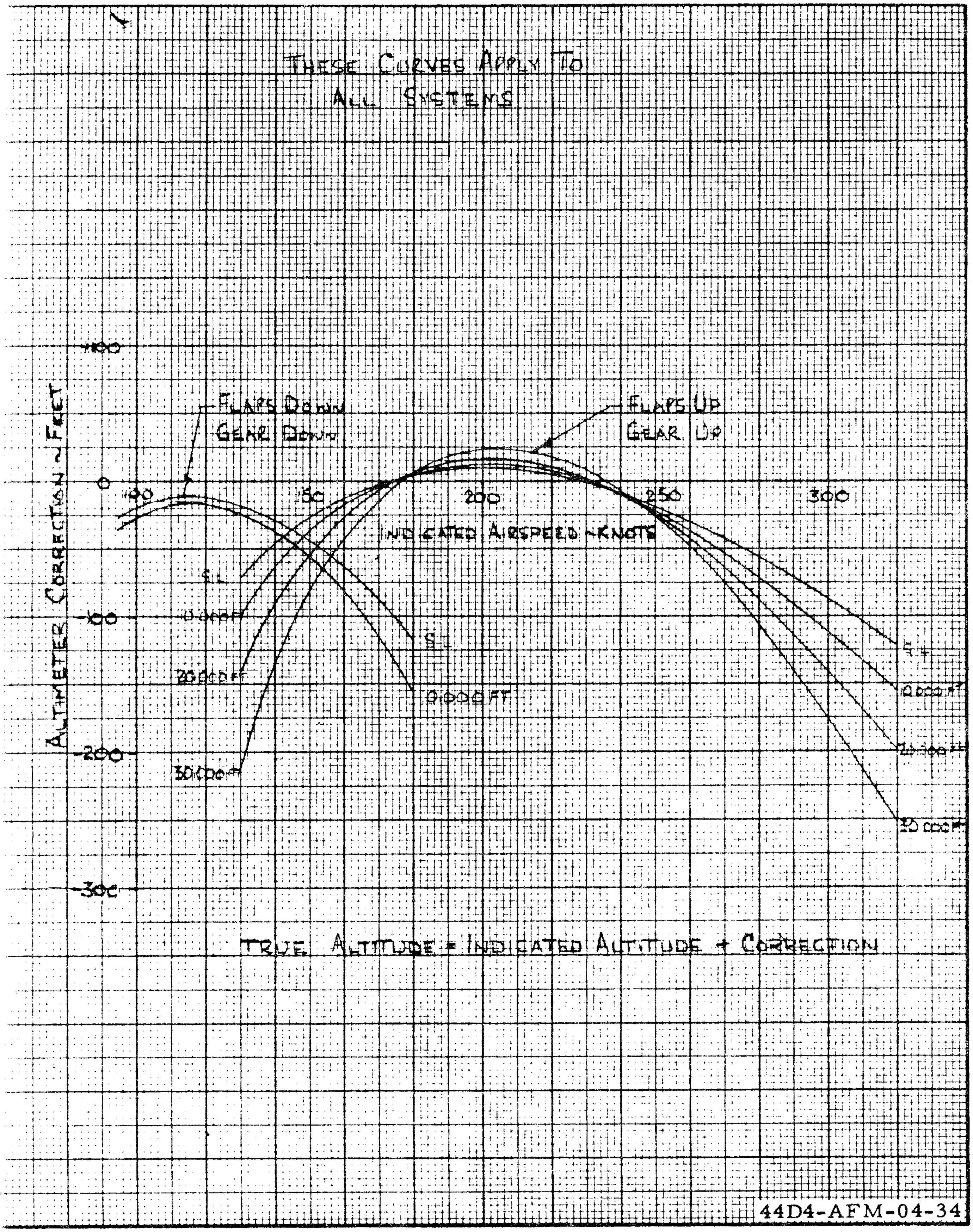


Maximum Landing Weight Permitted by Landing Runway Length at Alternate Destination

Figure 19



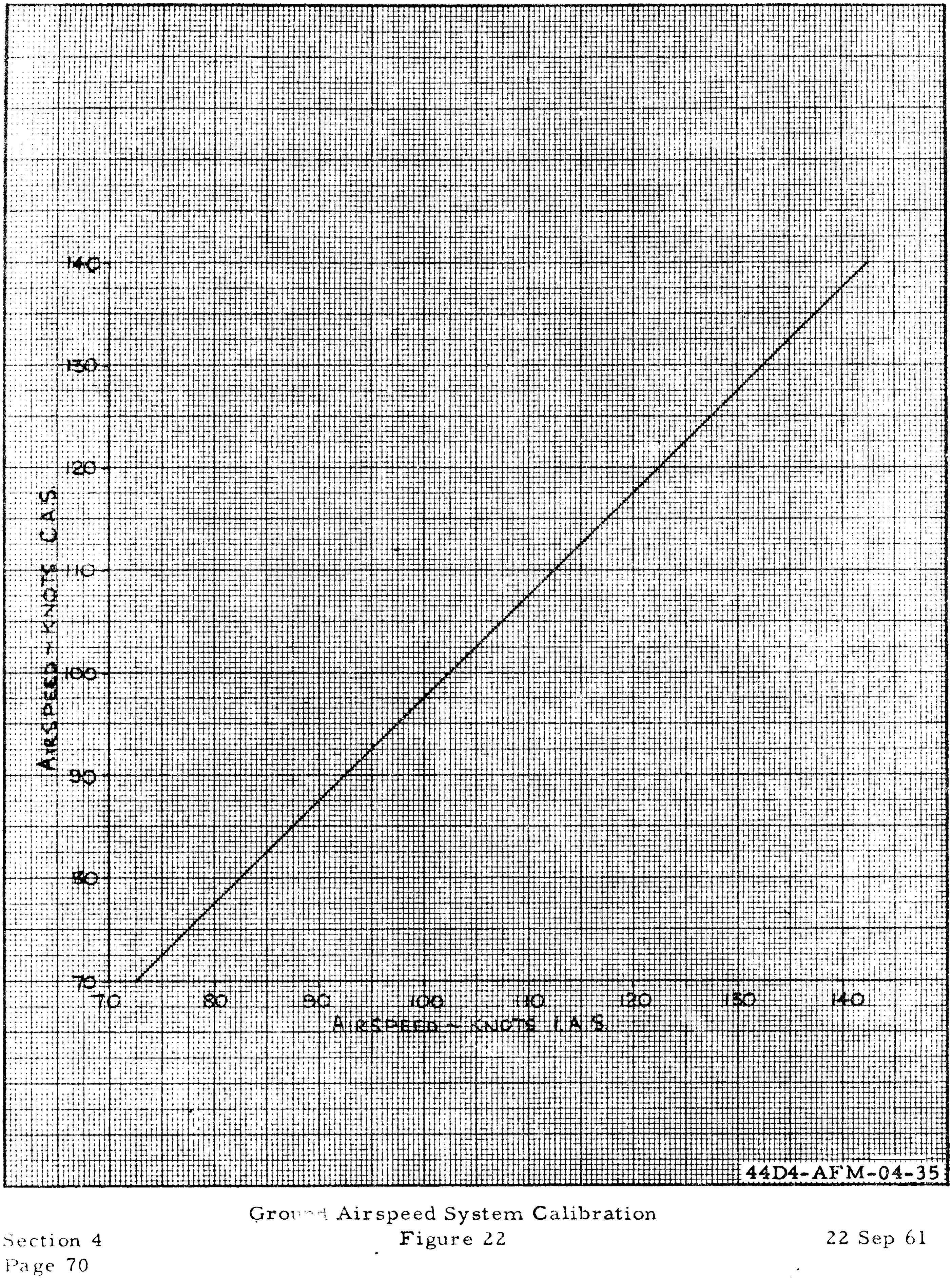
Airspeed System Calibration
Figure 20



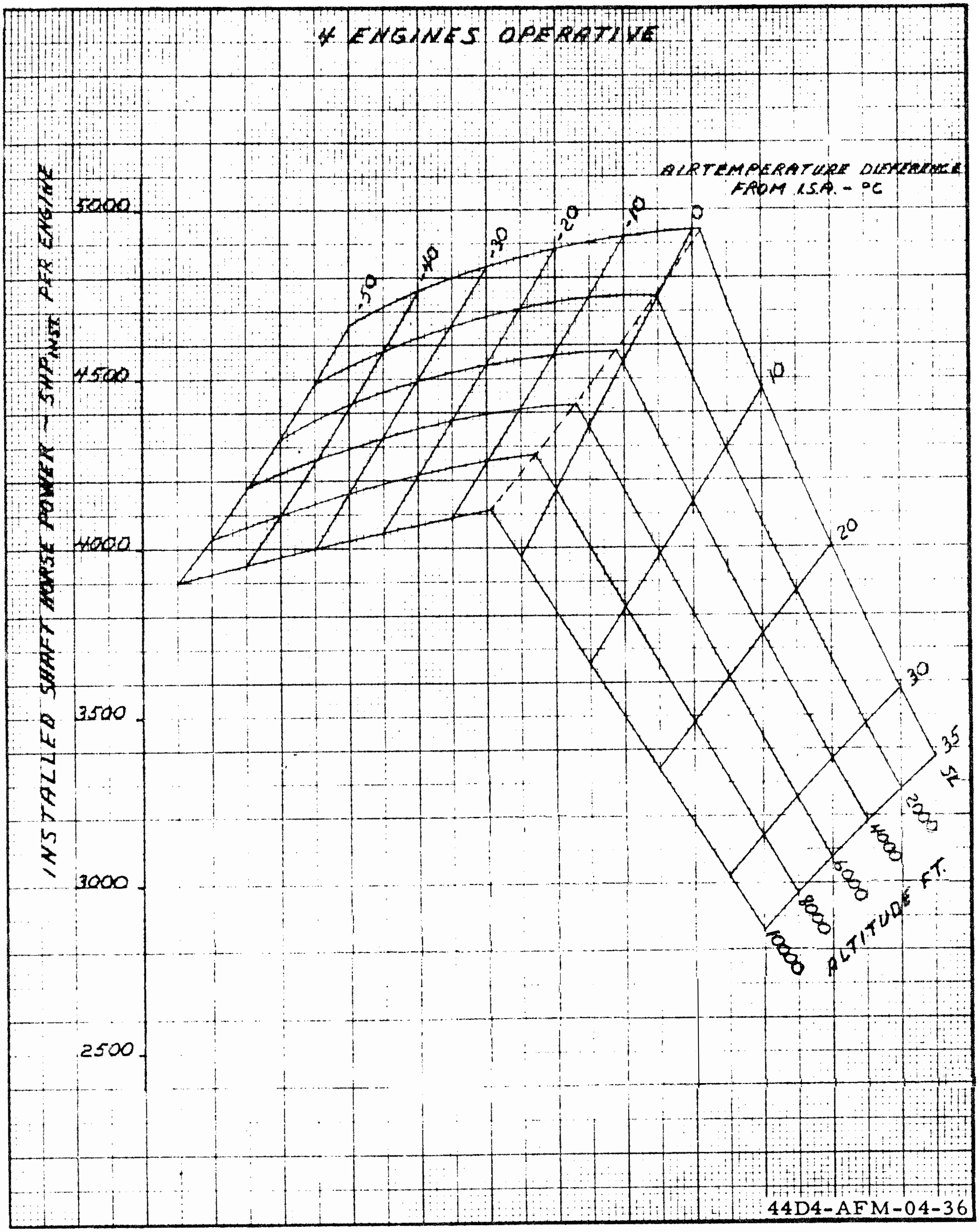
THESE CURVES APPLY TO ALL SYSTEMS

TRUE ALTITUDE = INDICATED ALTITUDE + CORRECTION

Alt ter System Calibration
Figure 21

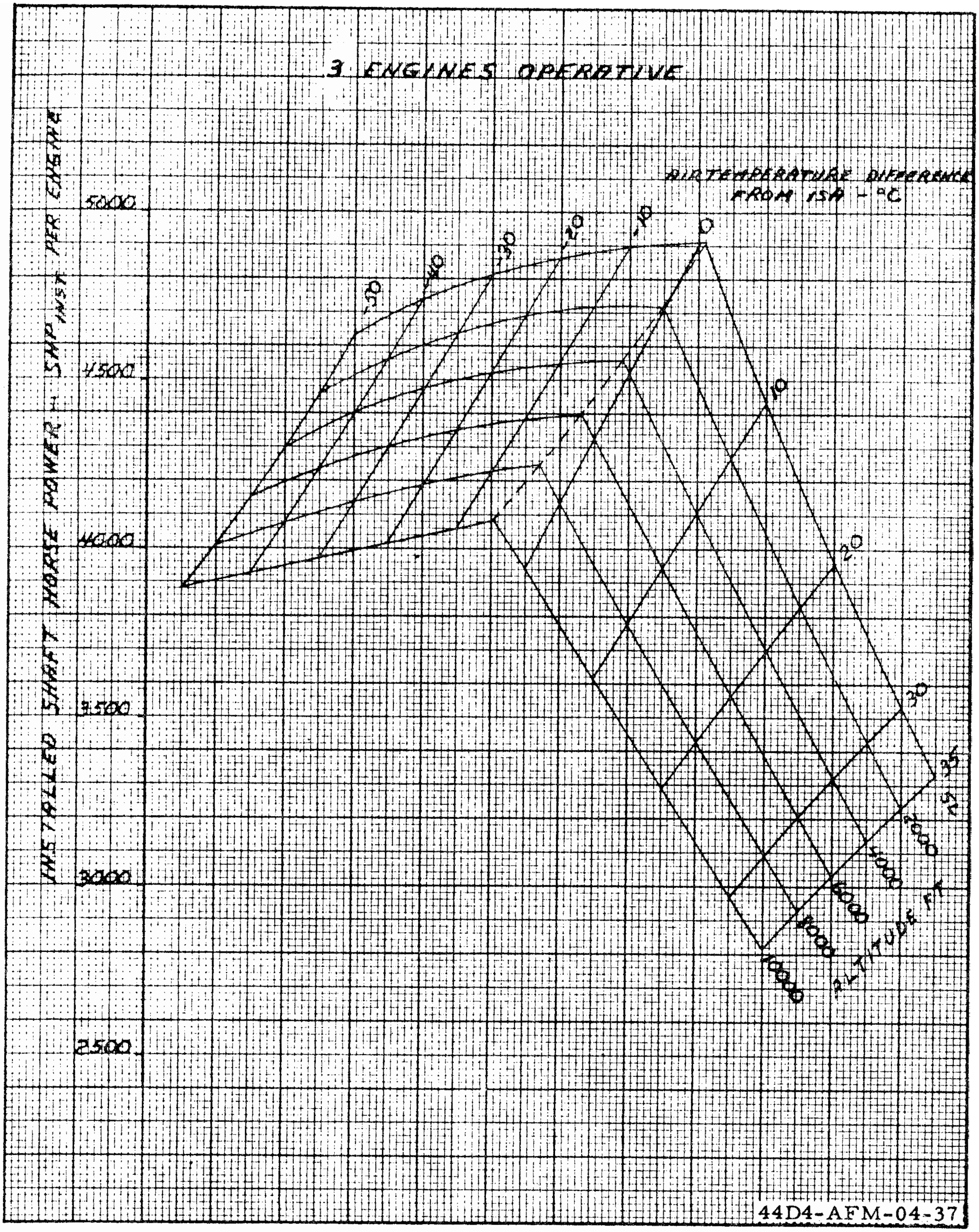


Ground Airspeed System Calibration
Figure 22

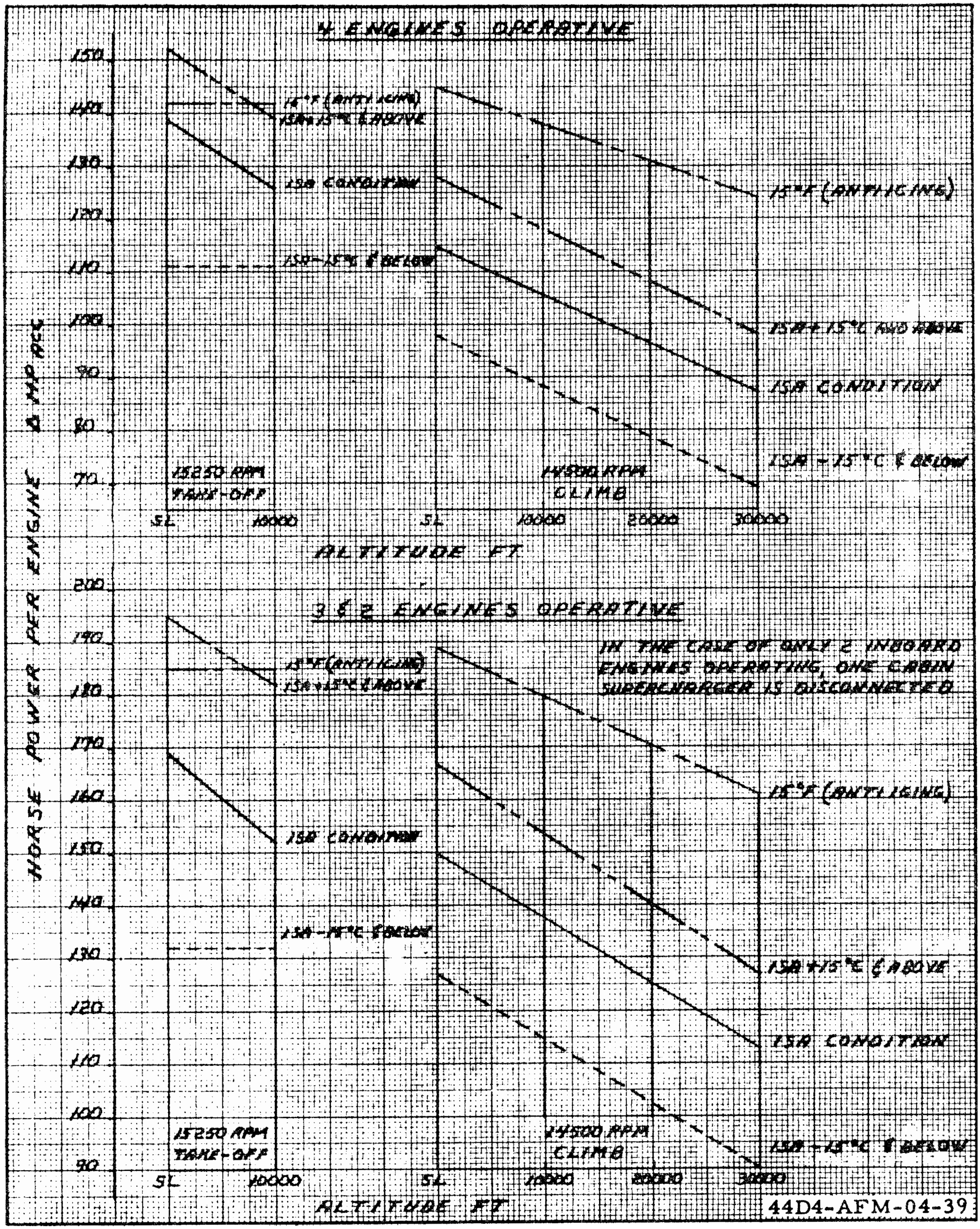


Minimum Engine Performance - Take-off - N_{LP} = 15,250 RPM - V_{EAS} = 135 Kts

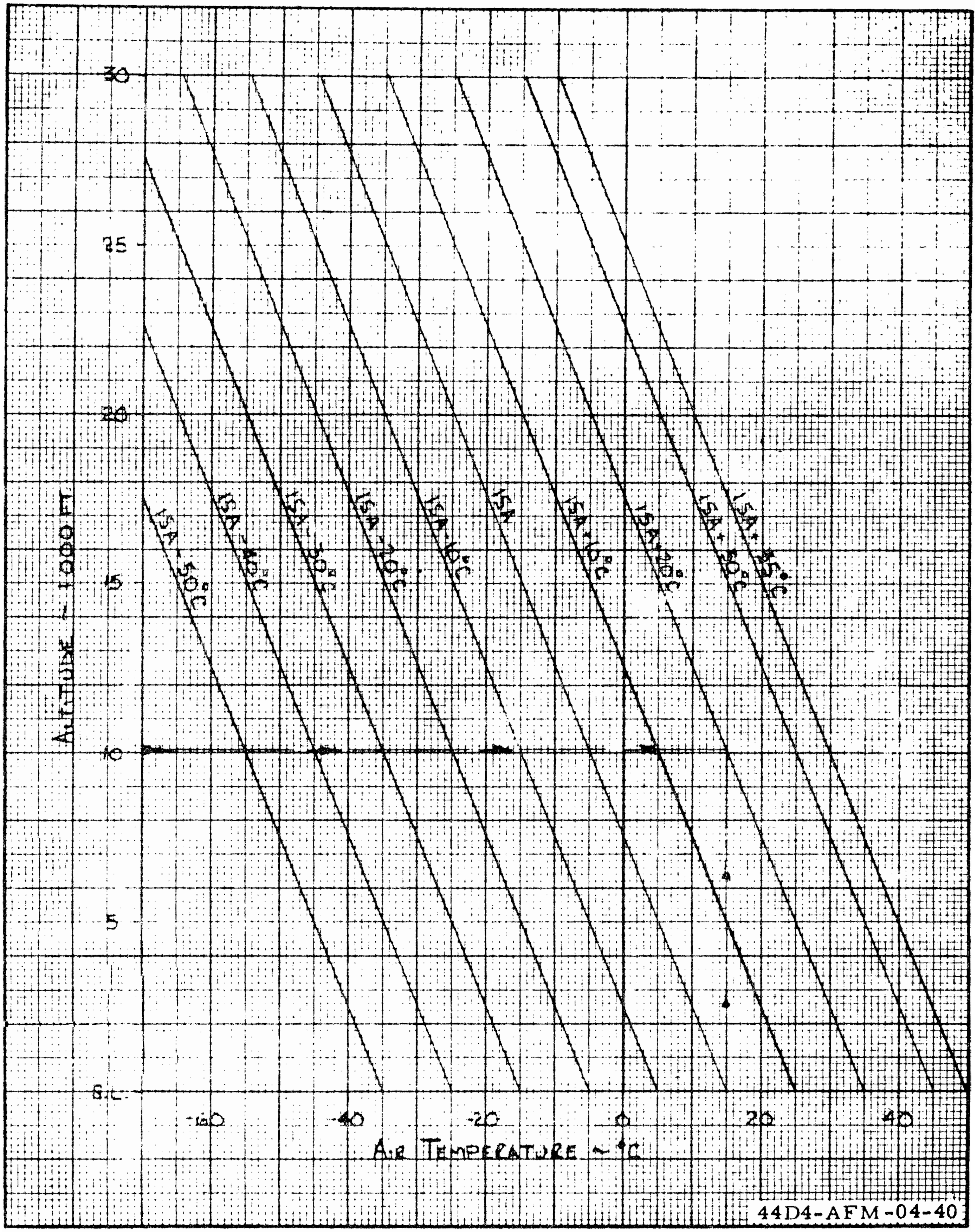
Figure 23



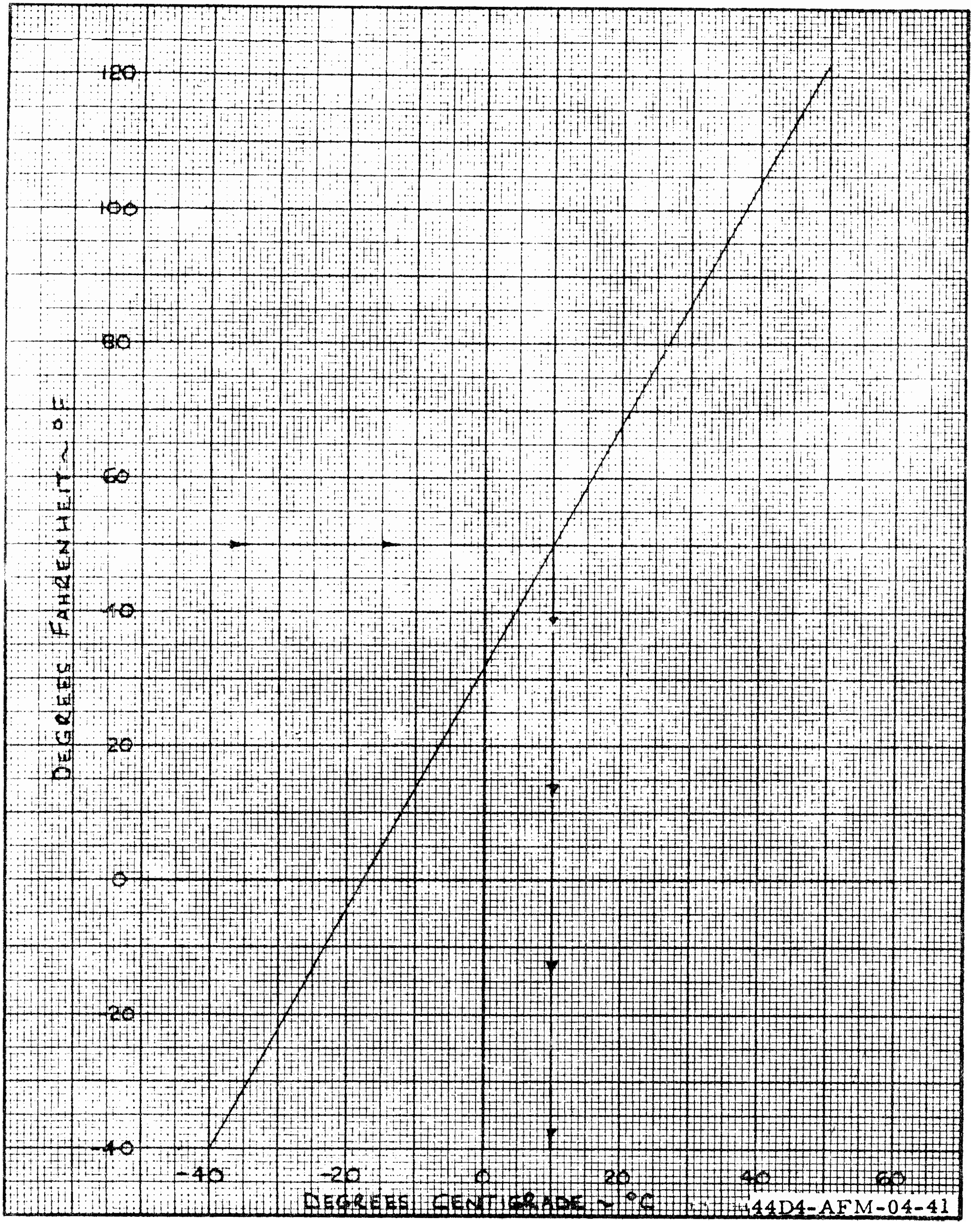
Minimum Engine Performance - Take-off - N_{LP} = 15,250 RPM - V_{EAS} = 135 Kts
Fi… 24



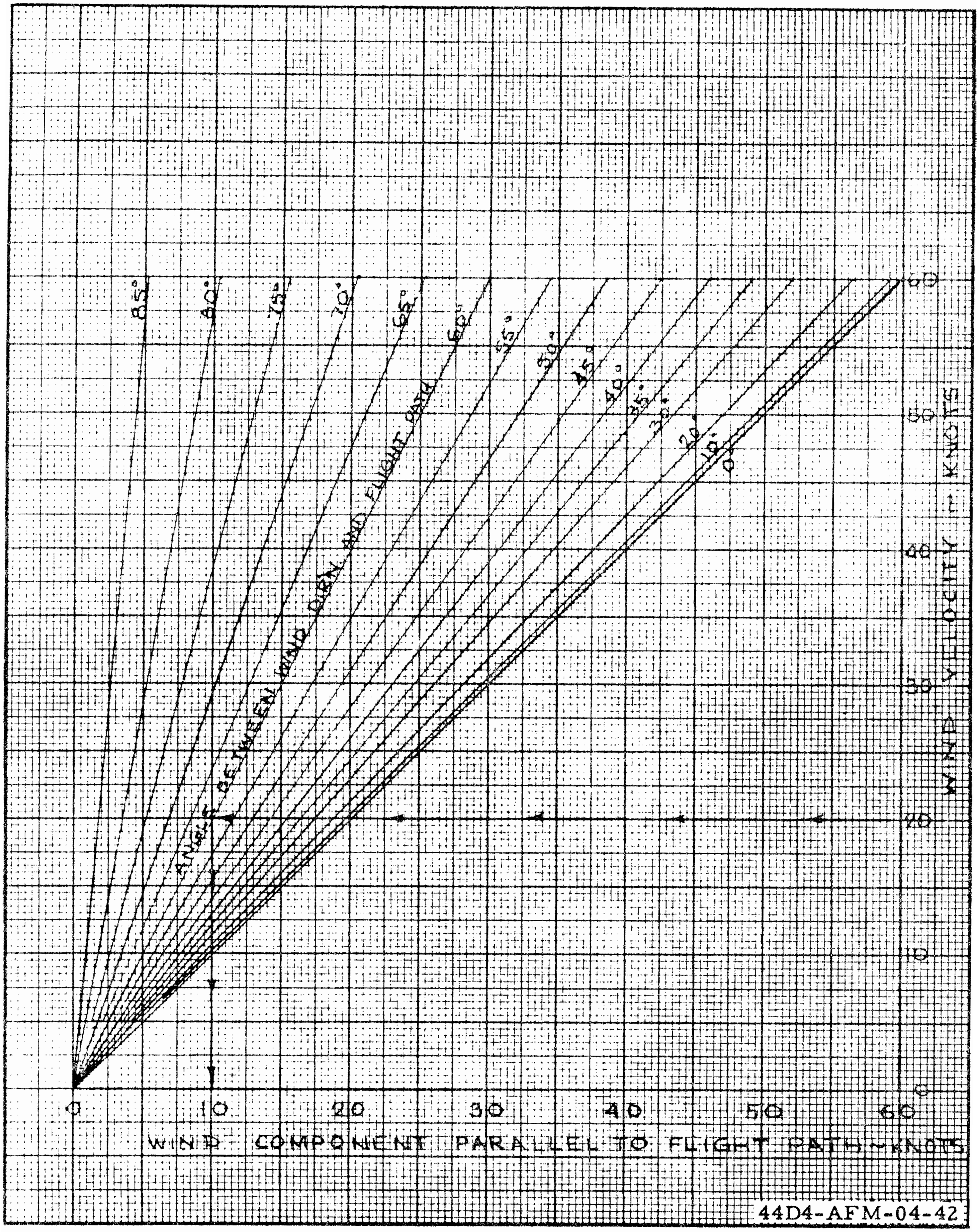
Accessory Power Off-take
Figure 26



Determination of Temperature in Relation to ISA
Figure 27



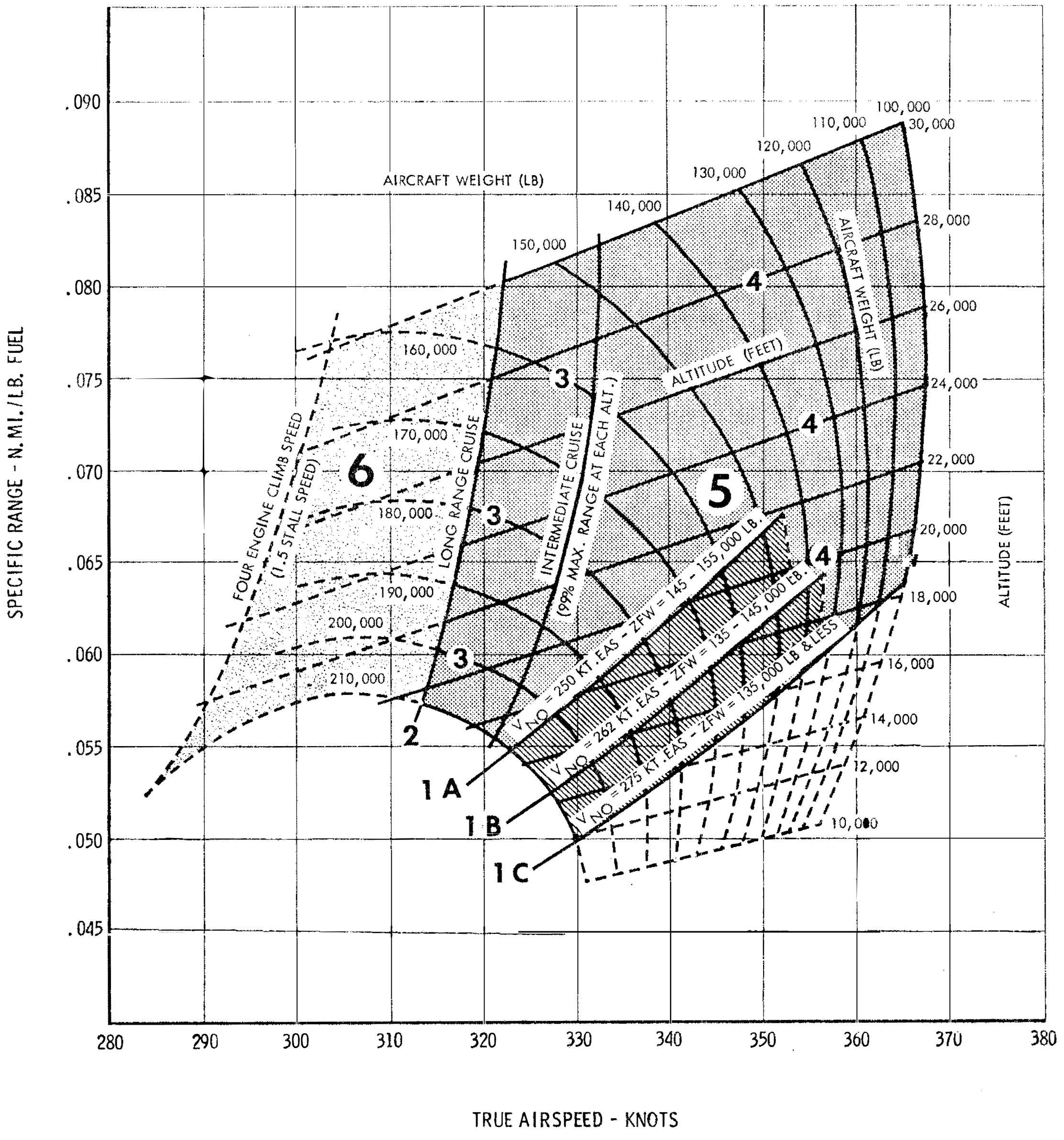
Temperature Conversion
Figure 28



Wind Component
Figure 29

FOUR ENGINE CRUISE GRID

88.5% LPRPM - 1164°K - ISA



44D4-OM-5-17A

Four Engine Cruise Grid 13, 500 LP RPM - 1164°K - ISA
Figure 1-1

C. It should be emphasized that the prime criterion is payload revenue which is of considerably greater value than the direct operating cost of the trip. In this regard, the cruising altitude should be selected such that enroute fuel requirements enable carrying the maximum possible payload. The appropriate Figure 1-5 to 1-7, depending upon the Zero Fuel Weight of the flight, should therefore be analysed, in conjunction with the forecast enroute winds and temperature anomly (variation from ISA) in order to determine the preferable altitude, based on the minimum trip fuel required. When a further reduction in trip fuel is necessary to accommodate payload, a long range cruise procedure should be used, as outlined in Paragraph 6.

When the required trip fuel would not interfere with the payload available, the minimum time procedure, at a lower flight level, may be performed.

The block speed for long range cruise is only in the order of 6 to 10 knots less than that for minimum time procedure.

D. Wind effects do not significantly influence the CL-44 cruise procedure in the usual operating region (5), at altitudes above those where serious V_{NO} limitations are encountered. Range increases in the order of 3-1/2% per 1,000 feet increase in altitude which would not be negated, unless the headwind component increased by 12 knots per 1,000 feet. Conversely, the same range would be attained at an altitude 1,000 feet lower than planned in the headwind component were reduced by 12 knots.

E. In consideration of minimum time operation, it will be noted that the TAS for a given weight will reduce at an average of approximately 2-1/2 knots per 1,000 feet increase of altitude. Thus when desiring minimum trip time, increased altitude would result in better ground speed only if the wind component reduces by more than 2-1/2 knots per 1,000 feet. On the other hand, lower altitudes where the V_{NO} limitations are encountered could be beneficial if the wind component reduces by more than 6 knots per 1,000 feet.

F. Over longer ranges, when specific altitudes are allotted, normal operation would include a step-climb. When the minimum-time procedure can be used (no payload restriction), the initial altitude should be selected, so that the V_{NO} speed is reached when the weight has reduced to the mid-cruise value, at which point, a step-climb is made to the higher altitude to avoid the V_{NO} restriction. The step-climb should be made at a constant rate of climb of 200 to 300 fpm with negligible effect on trip time and fuel planning. In an area where a change in altitude may not be approved, it may be preferable to seek a compromise level for the entire flight.

3. Weight, Speed and Fuel Limitations

The maximum design weights of the aircraft are as follows:

Maximum Take-off Weight	210,000 lb
Maximum Landing Weight	165,000 lb
Maximum Zero Fuel Weight	155,000 lb

The V_{NO} limited cruise speed of the CL-44, taken from the Flight Manual, is a function of Zero Fuel Weight as follows:

Zero Fuel Weight	Limit V_{NO} Knots, EAS	Approximate % Cargo Payload
Between 145,001 to 155,000 lb	250	85% to 100%
Between 135,001 to 145,000 lb	262	70% to 85%
135,000 lb and less	275	to 70%

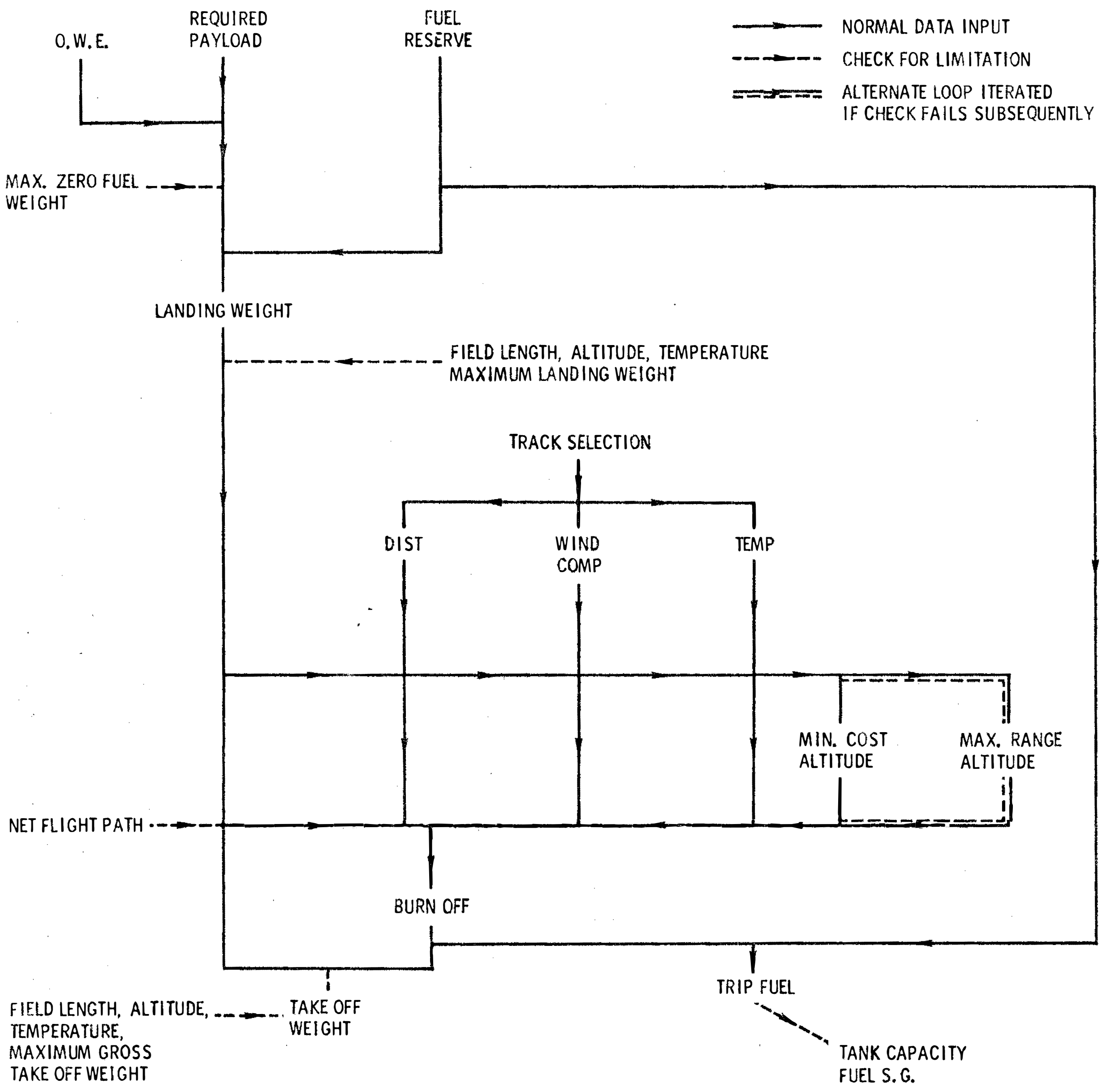
The V_{NO} restriction would be encountered at lower altitudes, which should be avoided as uneconomic and increasing trip time.

The fuel management operation is stated in Section 2 of the Flight Manual.

The usable and unusable quantities of fuel to the nearest 5 lb are as follows:

	Without Centre Tank		With Centre Auxiliary Tank	
	Usable	Unusable	Usable	Unusable
U.S. Gal Capacity	10,172	177	12,154	188
Weights at				
6.9 lb/U.S. Gal	70,185	1,220	83,865	1,295
6.8 lb/U.S. Gal	69,170	1,205	82,645	1,280
6.7 lb/U.S. Gal	68,150	1,190	81,430	1,260
6.6 lb/U.S. Gal	67,135	1,170	80,215	1,240
6.5 lb/U.S. Gal	66,120	1,150	79,000	1,220
6.4 lb/U.S. Gal	65,100	1,135	77,785	1,205

SCHEMATIC OF FLIGHT ANALYSIS



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Schematic of Flight Analysis
Figure 1-1A

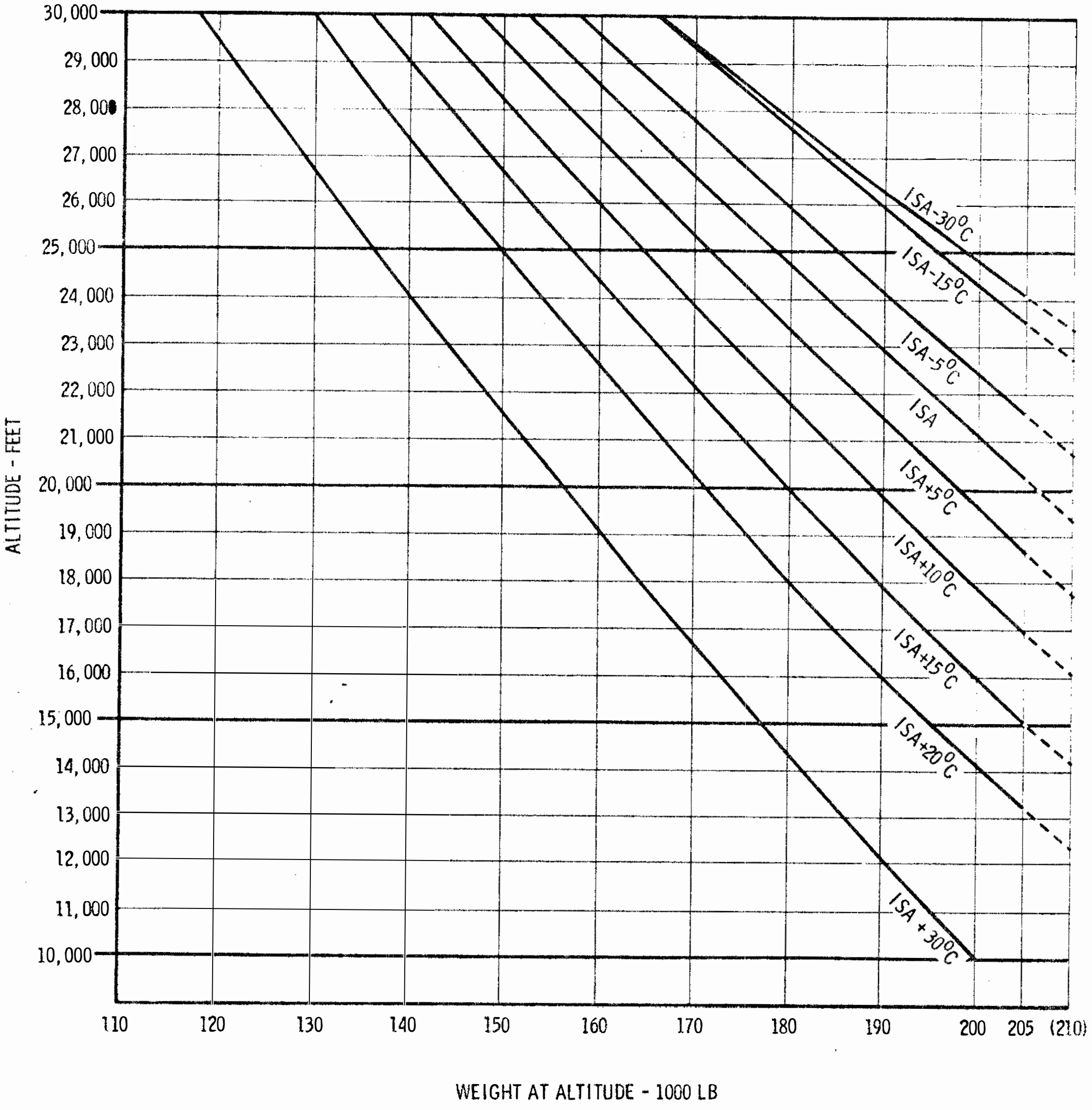
If cruise climb technique is not usable, step climbs should be conducted for maximum range. With enroute normal fuel consumption approximating 5, 000 lb per hour, and attainable cruise altitude varying by 1, 000 feet per 5, 000 lb change in weight, the steps would then be planned with hours elapsed at each altitude, dependent upon the number of 1, 000-foot increments in the altitude steps; that is, two thousand foot altitude steps would entail a minimum of two hours at each altitude.

For maximum range operation, the initial cruise altitude, obtained from Figure 1-2 would be as follows;

Ambient Temperature	Take-off Weight 210, 000 lb	205, 000 lb
ISA - 30°C	24, 000	25, 000
ISA - 20°C	24, 000	25, 000
ISA - 10°C	23, 000	24, 000
ISA	20, 000	21, 000
ISA + 10°C	17, 000	18, 000
ISA + 20°C	13, 000	14, 000

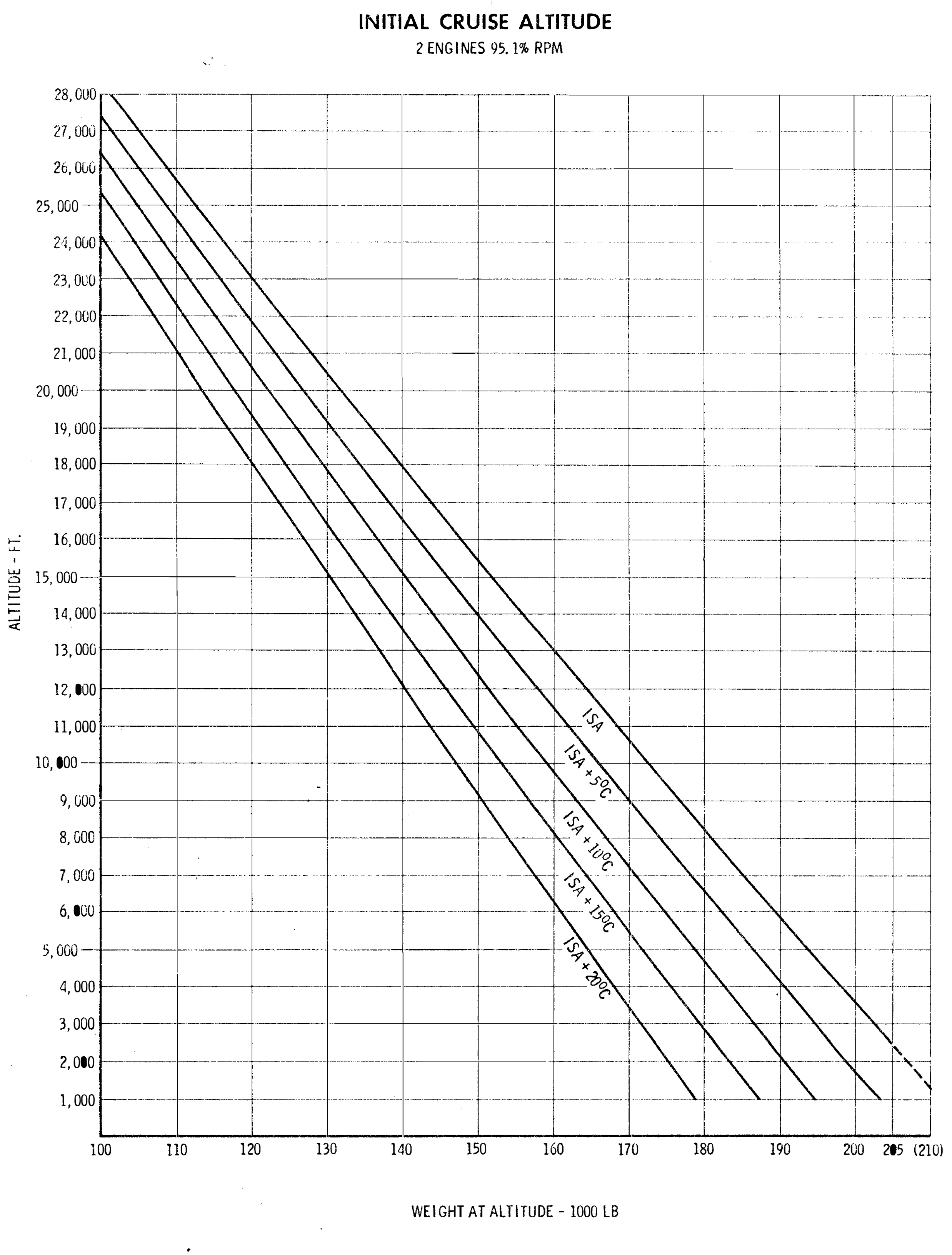
MAXIMUM CRUISE ALTITUDE

4 ENGINES AT 88.5% LPRPM - 1164°K



44D4-OM-5-1B

Maximum Cruise Altitude - Four Engines 88.5% RPM
Figure 1-2



Initial Cruise Altitude - Two Engines 95.1 % RPM
Figure 1-4

9. Flight Fuel, Take-off to Landing

The flight fuel required for normal four engine operation at 88.5% rpm and 1164°K are presented in the following Figures 1-5, 1-6 and 1-7, for the three main Zero Fuel Weights. Corrections for wind and temperature are included.

This data includes fuel for climb, cruise and normal descent, the latter initiated at the distance from destination as indicated in the Descent Table, page 2.85.

To present realistic and least optimistic data, the computations were made for the higher Zero Fuel Weight shown, with 10,000 lb fuel reserves. For this weight configuration, the shaded portion serves as a reminder that payload may be limited when the flight plan fuel exceeds 40,000 lb, at the full 205,000 lb take-off weight, or with 45,000 lb of fuel at the 210,000 lb take-off weight.

18. Maximum Landing Weight Permitted by Landing Runway Length at Alternate Destination

The landing runway length for alternate destinations is shown in Figure 19.

The landing runway length is defined as the actual landing distance from 50 feet divided by 0.7.

Associated Conditions:

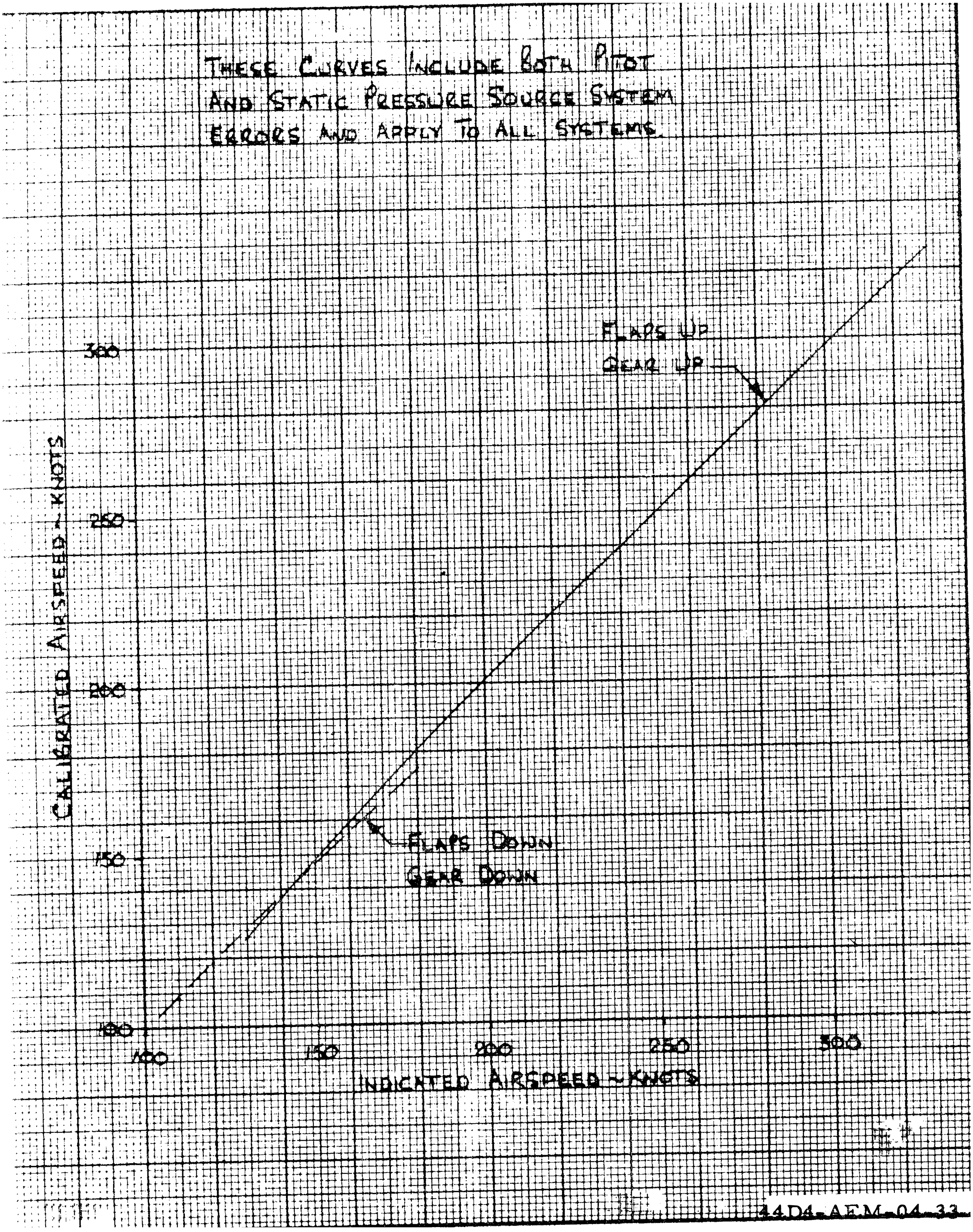
Wing flaps	45°
Landing gear	Extended
Runway	Hard, dry surface
Anti-skid units	Operative
Approach speed	As shown on Figure 19.

Example

The example given shows that with a landing runway length of 4720 feet, a reported headwind of 28 knots and an airport altitude of 1500 feet, the maximum landing weight is 162,800 pounds. The corresponding approach speed is 122 knots IAS.

NOTES: (1) The wind correction grid is factored; reported winds may be used directly.

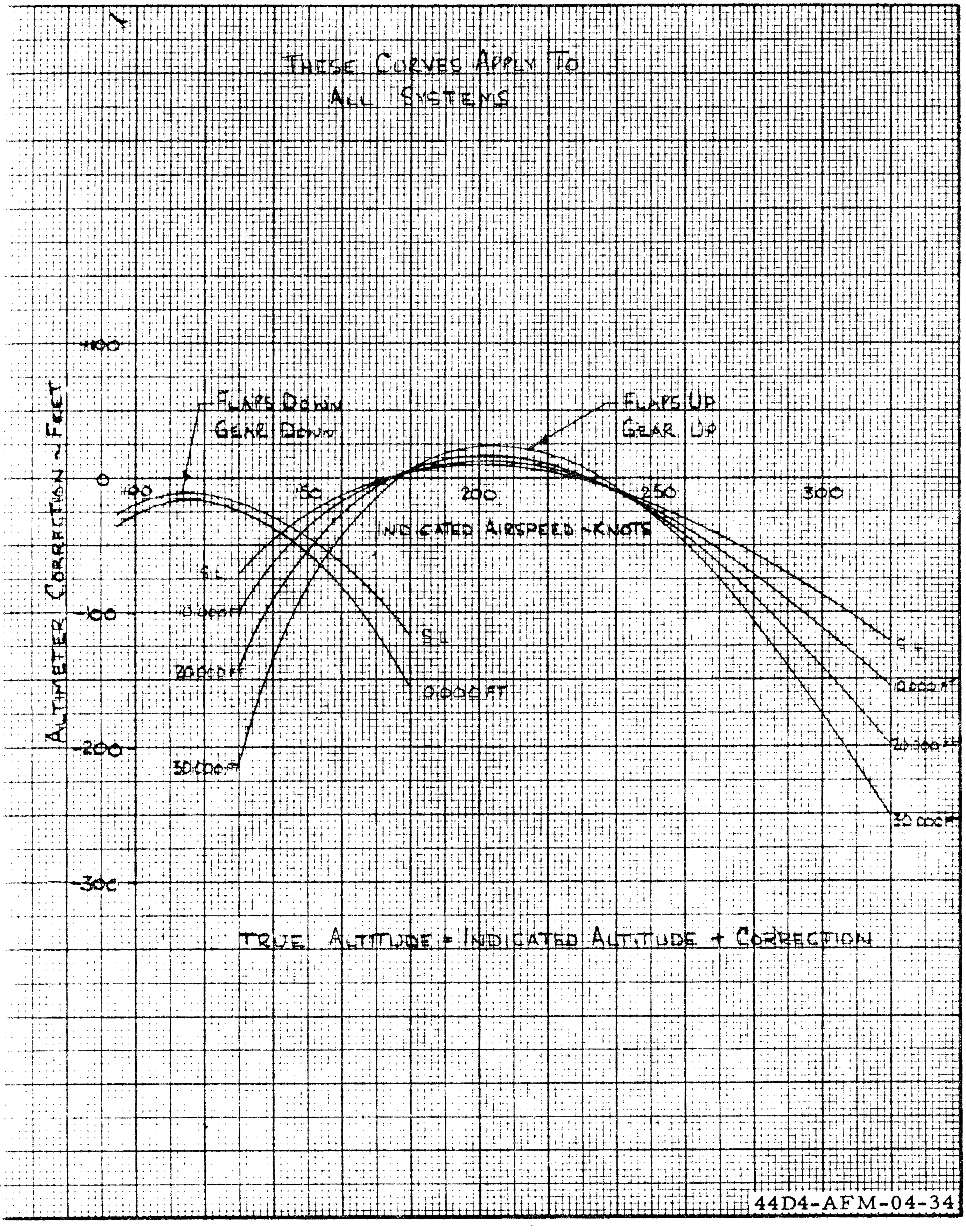
(2) For landing weights below 120,000 pounds, use approach speed and landing runway length for 120,000 pounds.



Airspeed System Calibration
Figure 20

19. Airspeed System Calibration

Calibration of the airspeed system is shown in Figure 20. These curves apply to the pilots, co-pilots and flight recorder systems.

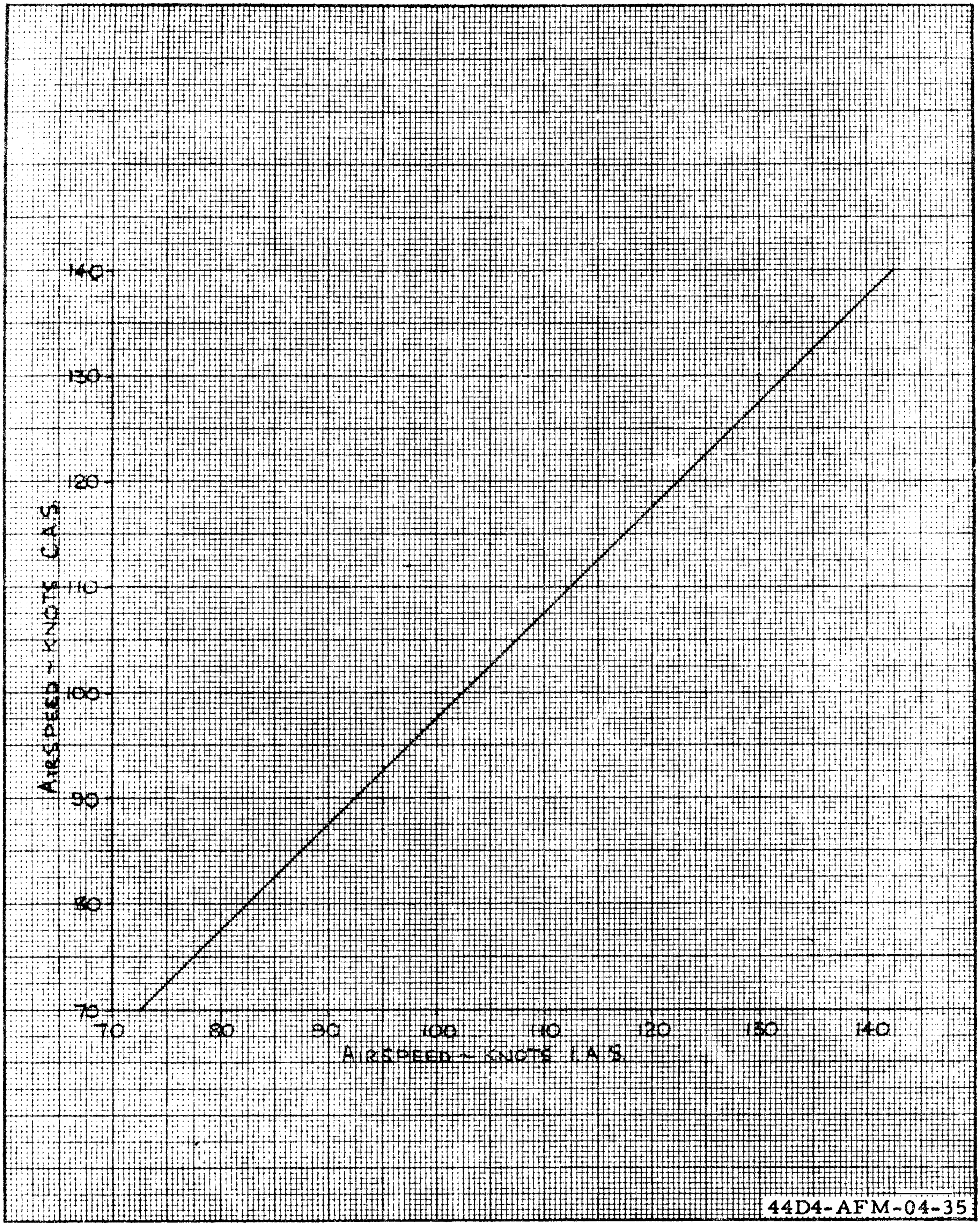


44D4-AFM-04-34

Altimeter System Calibration
Figure 21

20. Altimeter System Calibration

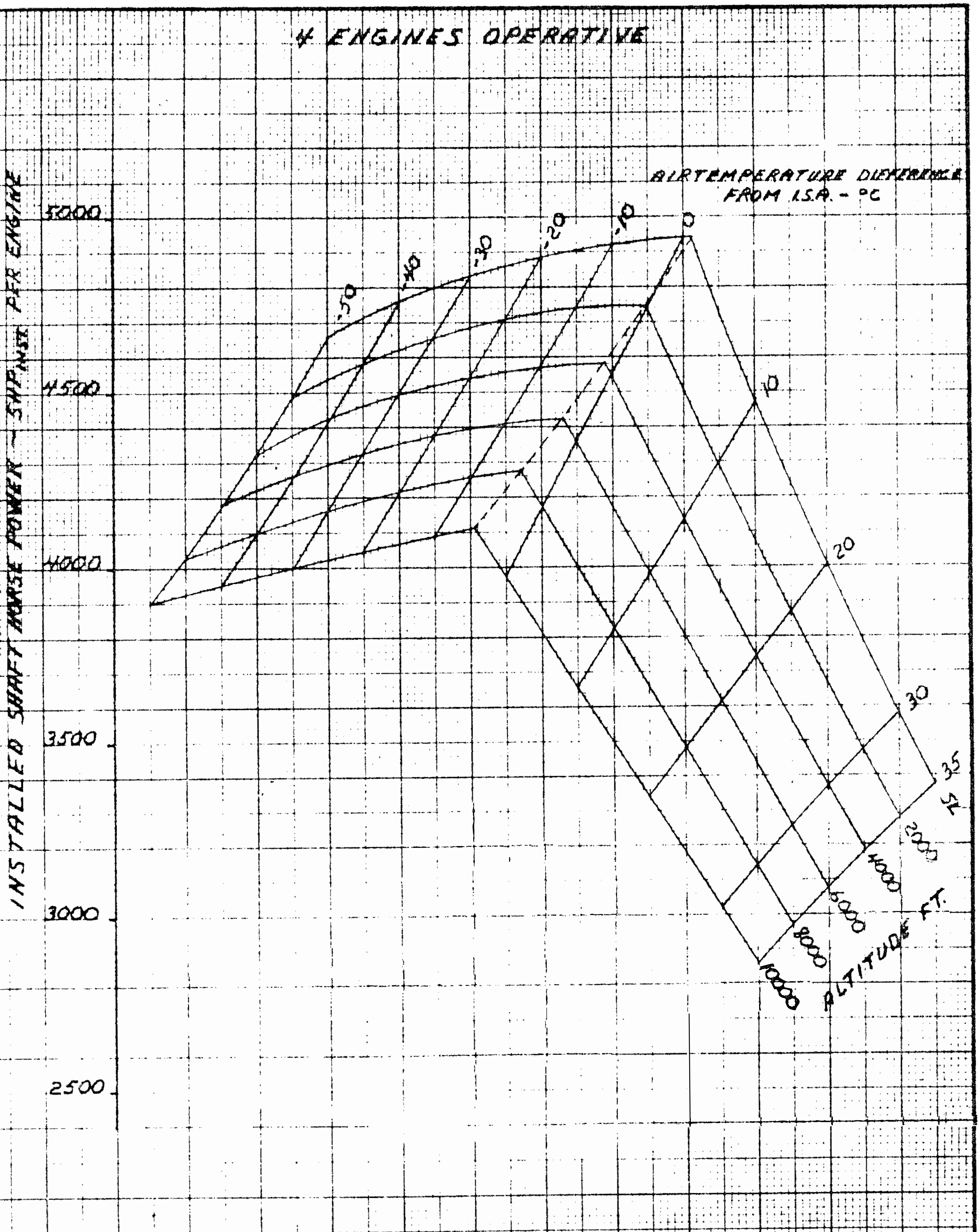
Calibration of the altimeter system is shown in Figure 21. The curves apply to the pilots, co-pilots and flight systems. To obtain the true altitude, add the correction algebraically to the indicated altitude.



Ground Airspeed System Calibration
Figure 22

21. Ground Airspeed System Calibration

Calibration of the airspeed system on the ground is shown in Figure 22.



Minimum Engine Performance - Take-off - N_{LP} = 15,250 RPM - V_{EAS} = 135 Kts
Figure 23

22. Installed Engine Power Calibration

A. Take-off Shaft Horsepower

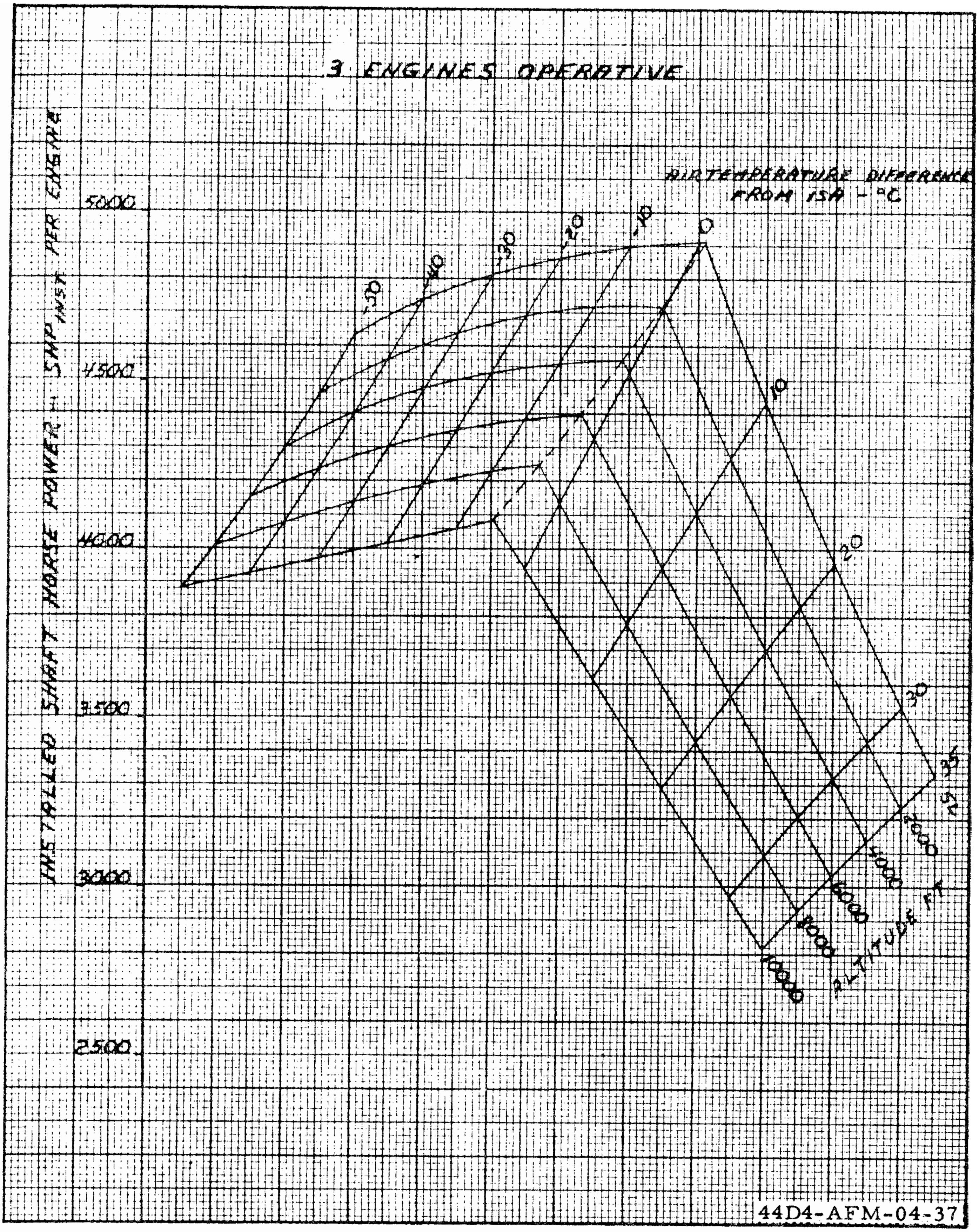
The minimum installed take-off shaft horsepower used in the computation of airplane performance is shown in Figures 23 and 24 for the four engine and three engine operating cases respectively. These data have been confirmed by flight test and are based on gear-box off-takes as presented in Figure 26.

B. Maximum Continuous Shaft Horsepower

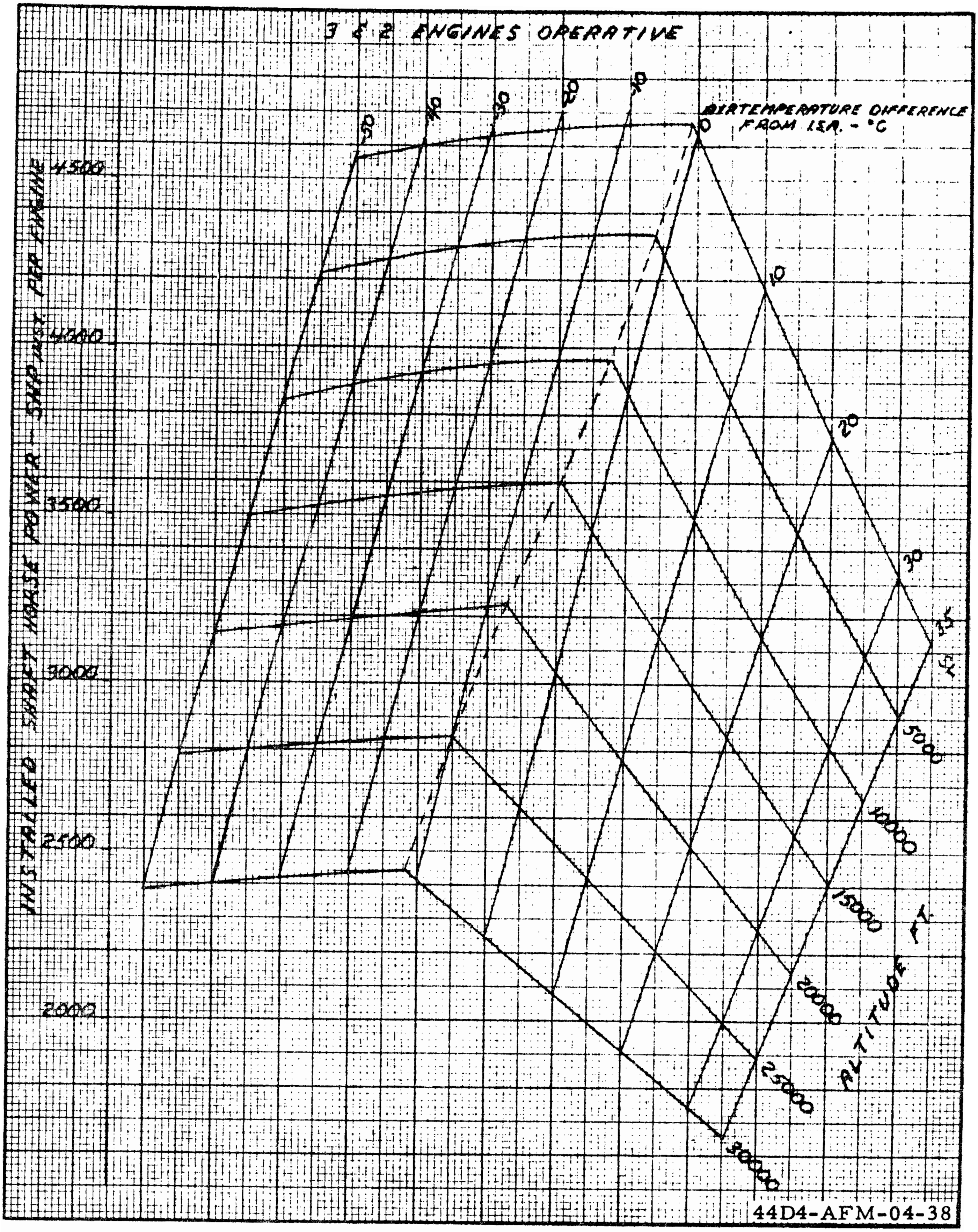
The minimum installed shaft horsepower used in the computation of the airplane performance is presented in Figure 25 for both three engine and two engine operating cases. These data have been confirmed by flight test and are based on the gear-box off-takes given in Figure 26.

C. Performance with Anti-icing System Operative

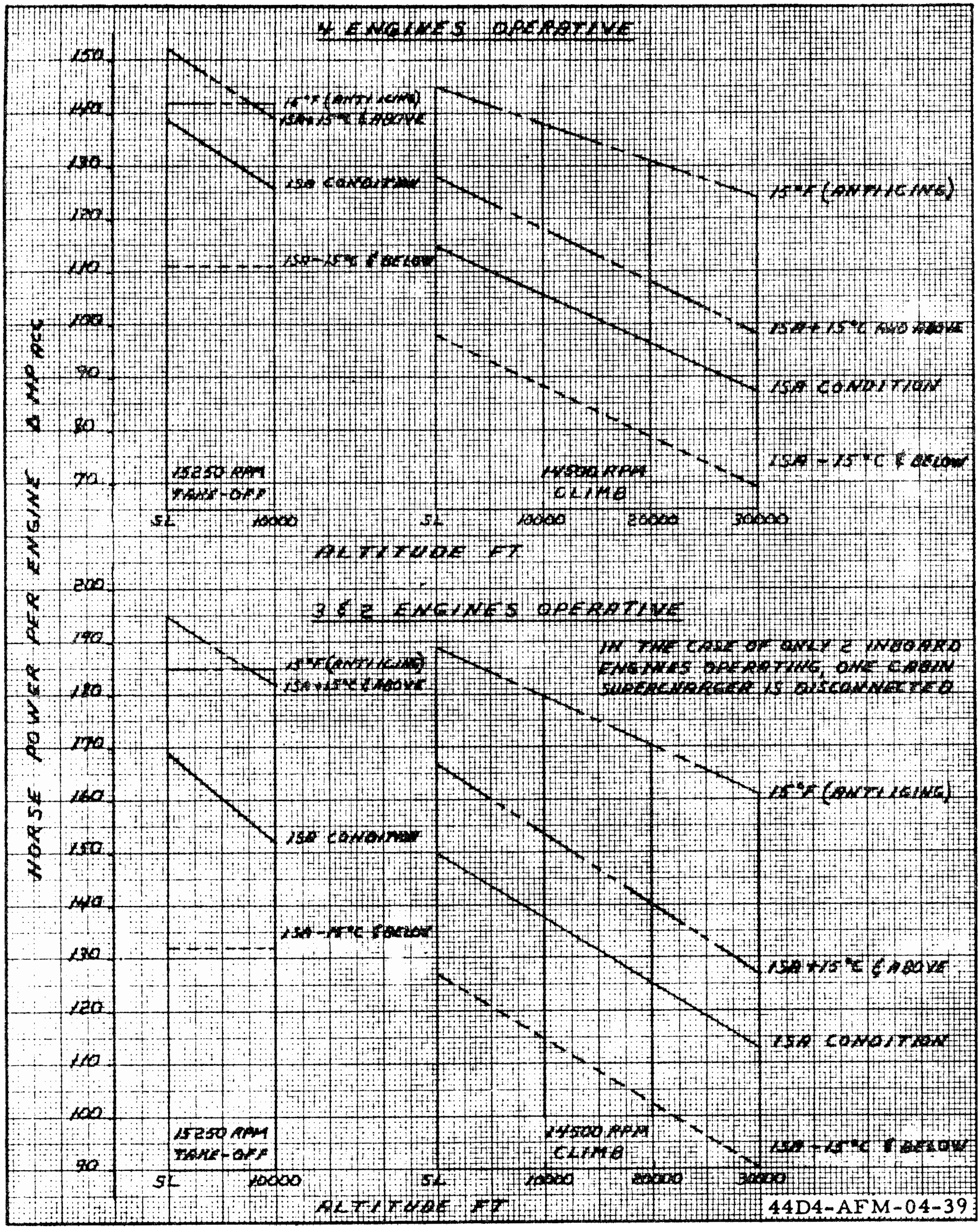
The minimum installed shaft horsepower for enroute climb with engine and aircraft anti-icing systems selected can be obtained by reducing the corresponding values read from Figure 25 by 15% and subtracting the difference in power off-takes between anti-icing ON and OFF from Figure 26. For take-off only, the difference between the anti-icing ON and OFF cases must be subtracted from the powers given in Figures 23 and 24, since engine inlet guide vane anti-icing is not required when using take-off power within the 5-minute limitation.



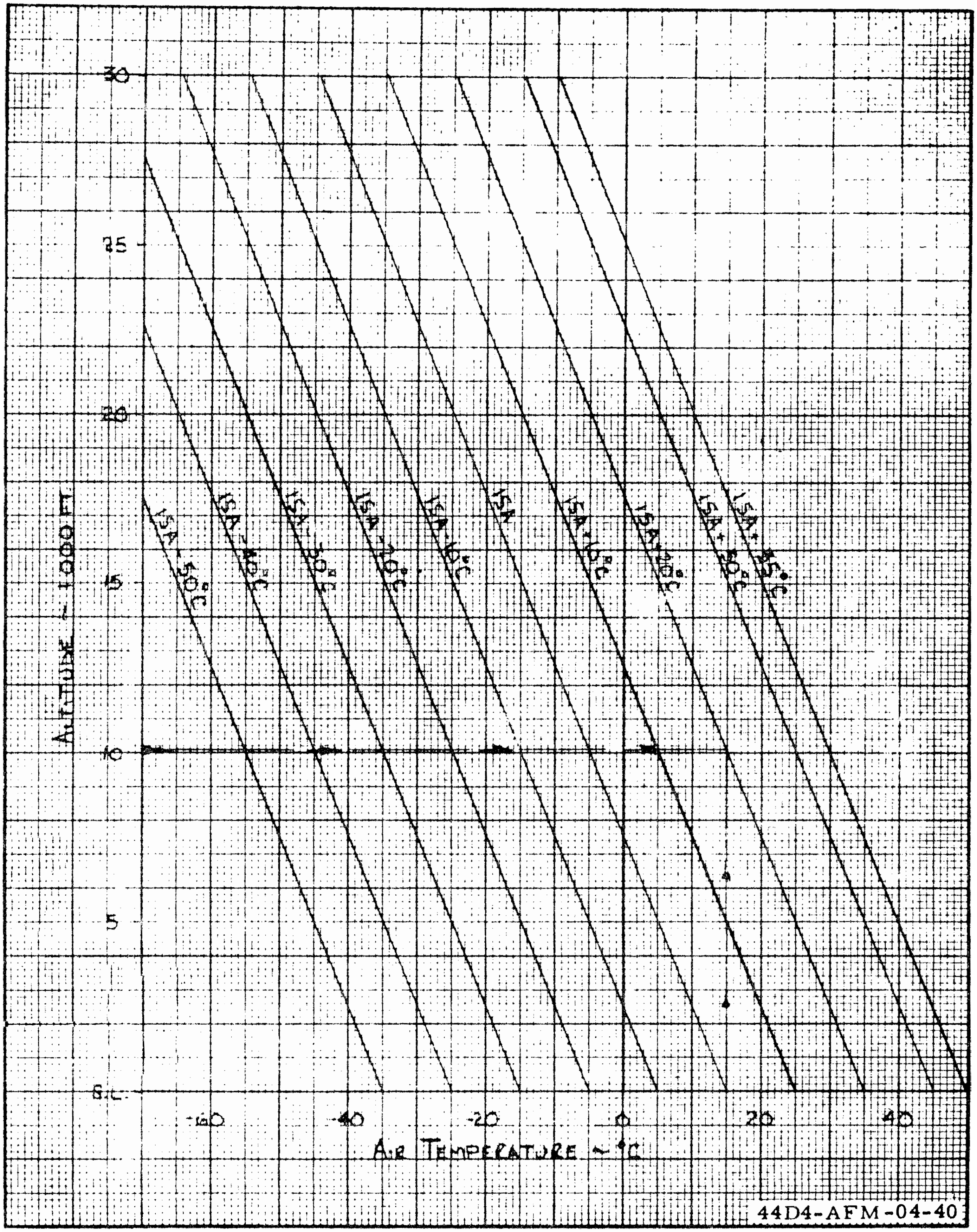
Minimum Engine Performance - Take-off - N_{LP} = 15,250 RPM - V_{EAS} = 135 Kts
Fi 24



Minimum Engine Performance - Climb - N_{LP} = 14,500 RPM - V_{EAS} = 181 Kts
Figure 25



Accessory Power Off-take
Figure 26

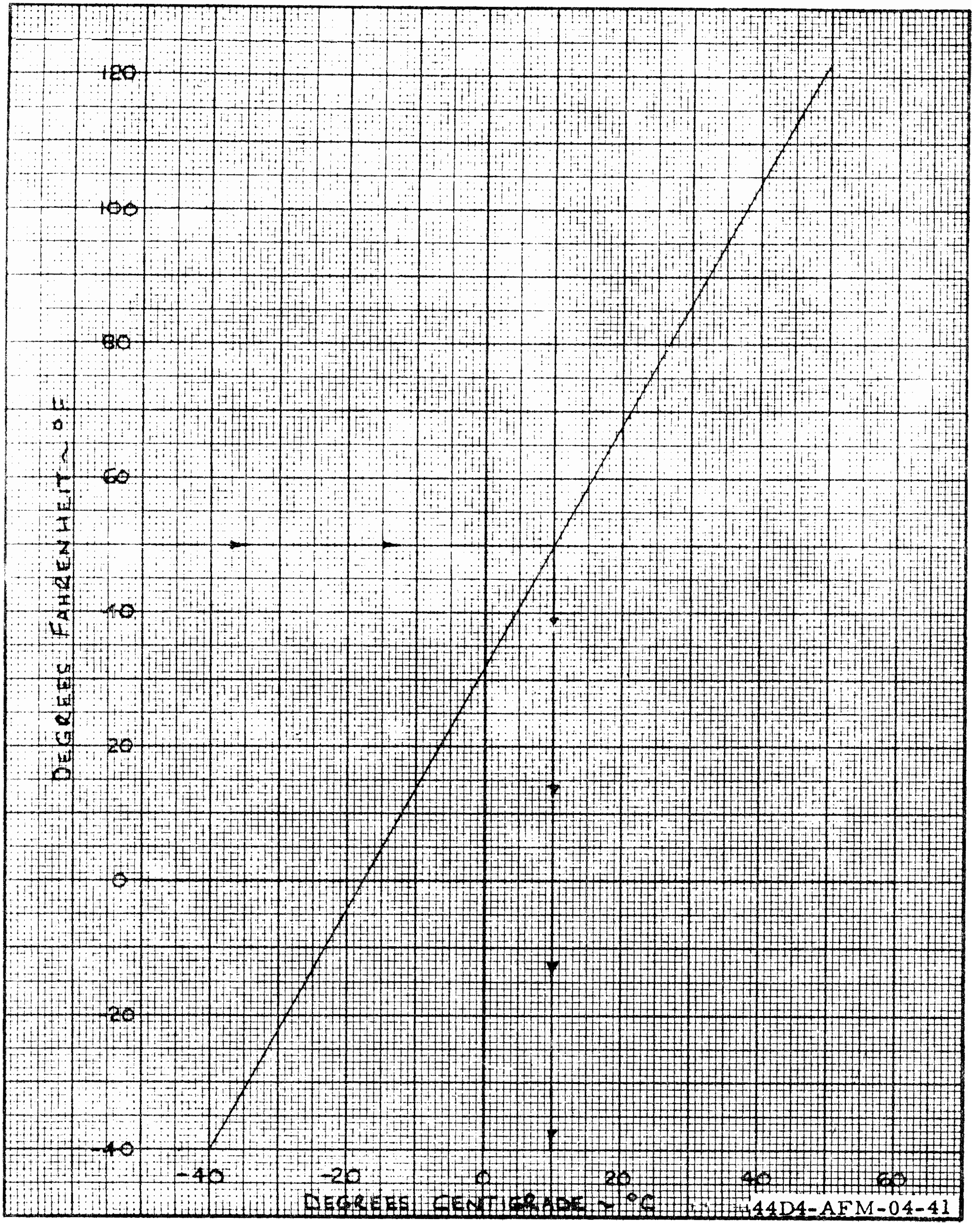


Determination of Temperature in Relation to ISA
Figure 27

23. Determination of Temperature in Relation to ISA

A chart for the determination of temperature in relation to International Standard Atmosphere is shown in Figure 27.

The example shows that at a temperature of 15° C and an altitude of 10,100 feet, the temperature is equal to ISA + 20° C.

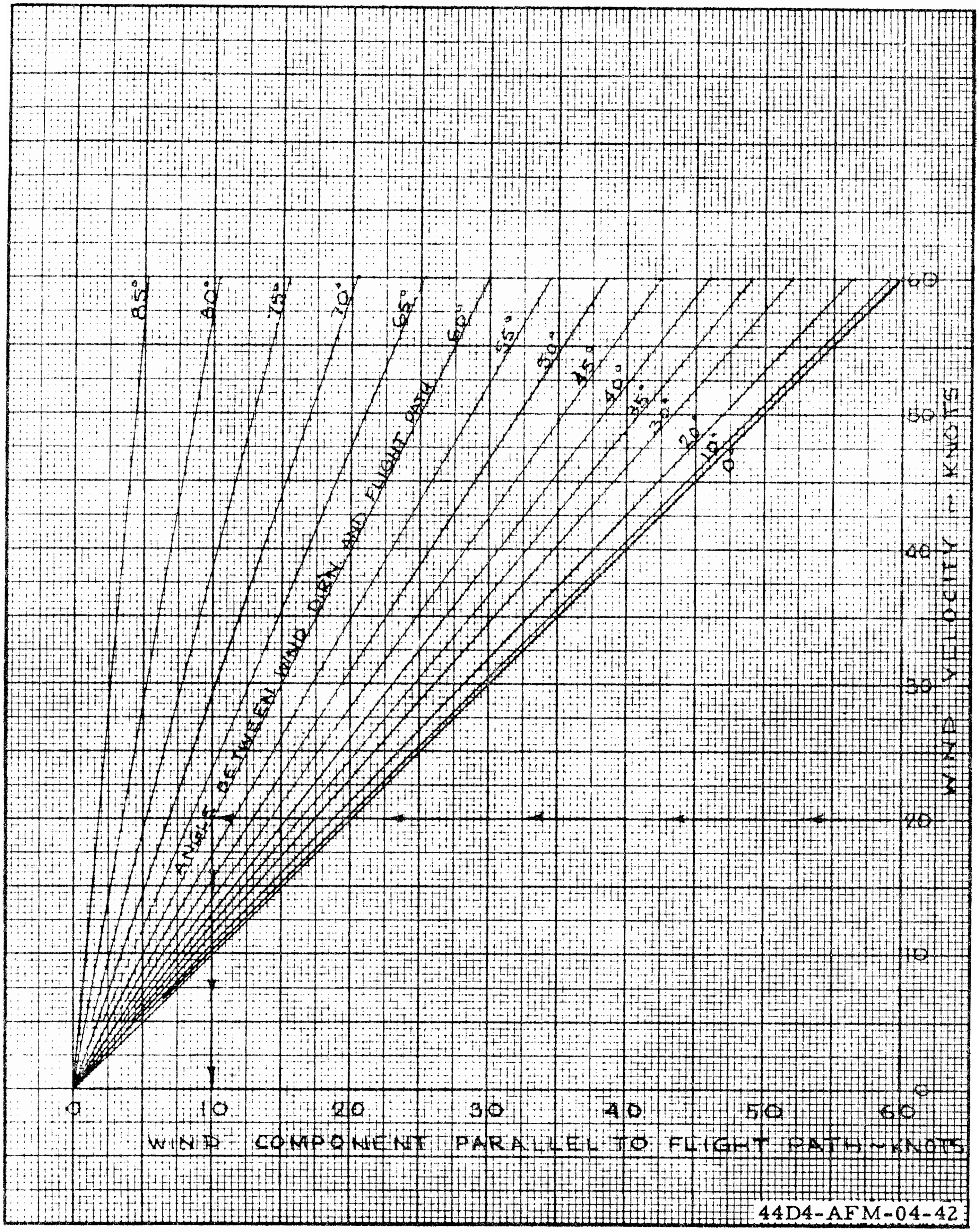


Temperature Conversion
Figure 28

24. Temperature Conversion

A chart to convert degrees Fahrenheit to degrees Centigrade is shown in Figure 28.

The example given shows that 50° F is equivalent to 10° C.



Wind Component
Figure 29

25. Wind Component

A chart to convert wind velocity into a headwind or tailwind component is shown in Figure 29.

The example shows that for a wind velocity of 20 knots at an angle of 60° to the flight path, the wind component parallel to the flight path is 10 knots.

SECTION 5

FLIGHT PLANNING AND CRUISE CONTROL DATA

PART 1

1. Introduction

The attached Flight Planning and Cruise Control Data for the CL-44 are presented primarily in tabular chart form, at the request of the operators.

The recommended normal climb and cruise engine power is limited, for an interim period, to 13,500 rpm (88.5% LP rpm) and 1164°K Turbine Entry Temperature, as recommended by Rolls Royce Ltd. to the operators.

The climb and cruise performance data pertains to temperatures ranging from ISA - 30°C to ISA + 20°C. The normal four engine cruise performance is given for every thousand feet from 10,000 to 24,000 feet, and for every 2,000 feet thereafter to 30,000 feet.

The material is grouped into three parts for usage, namely:

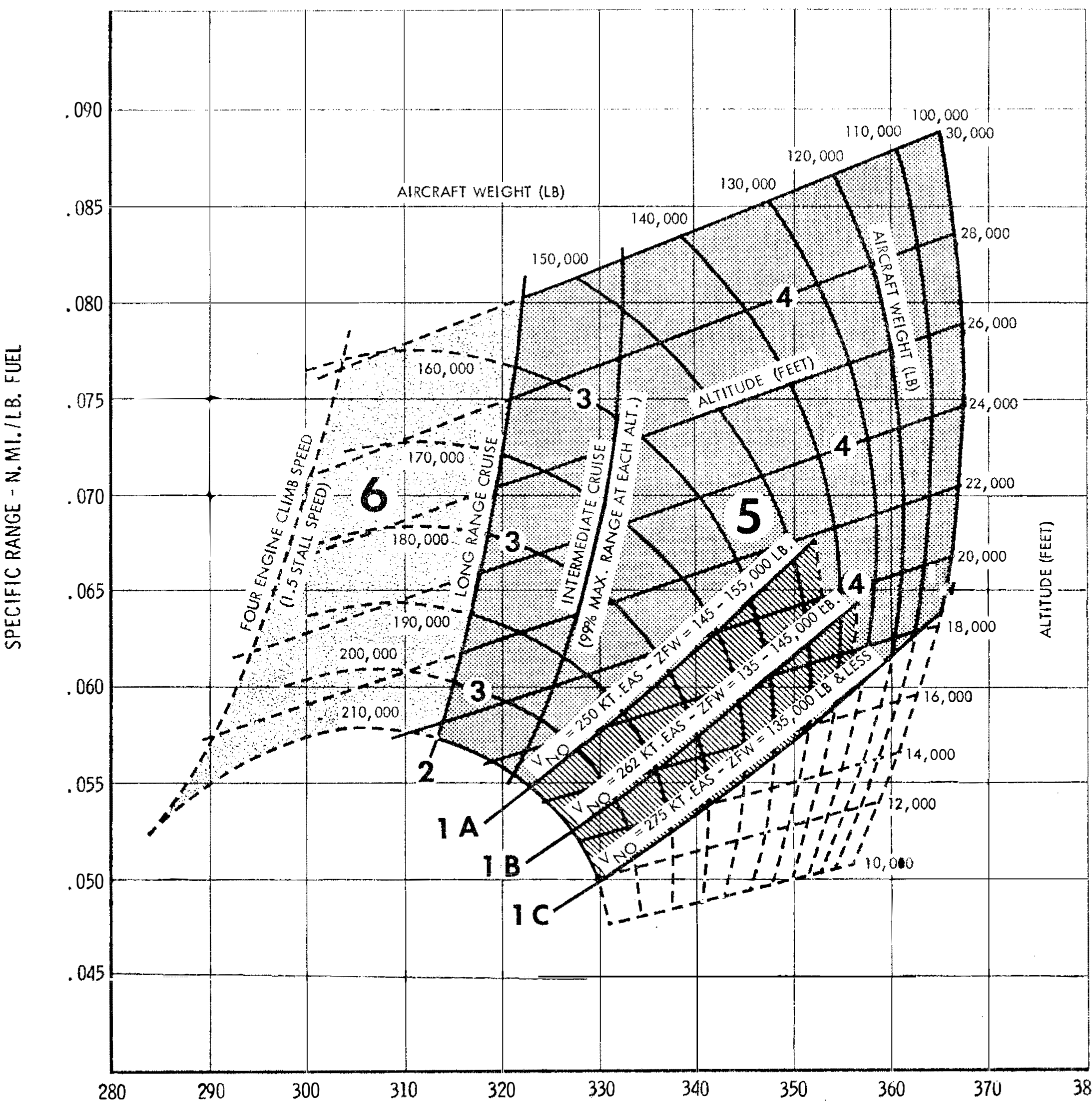
PART 1	That used in Flight Analysis and Planning.
PART 2	That used in normal operation for Cruise Control.
PART 3	That pertaining to engine-out operation.

All operations must be conducted within the limits specified in the CL-44D4 AIRPLANE FLIGHT MANUAL.

Speeds and distances are given in knots and nautical miles.

FOUR ENGINE CRUISE GRID

88.5% LPRPM - 1164°K - ISA



44D4-OM-5-17A

Four Engine Cruise Grid 13, 500 LP RPM - 1164°K - ISA
Figure 1-1

2. General

A. Normal four engine operation of the CL-44 is conducted at maximum recommended cruise rpm, both for long range and minimum time procedures. Less than maximum rpm should only be used when restricted to a lower altitude or when flying at a V_{NO} limited speed.

B. A cruise grid is presented in Figure 1-1 to more clearly illustrate the operational aspects of the CL-44 as referred to in succeeding notes. The vertical scale shows specific range in nautical air miles per lb of fuel while TAS in knots is presented in the horizontal scale. The V_{NO} limit lines sloping upward to the right identified as (1), restrict the maximum allowable TAS as a function of design structural strength, i.e., (1A) dictates the maximum allowable TAS when the Zero Fuel Weight falls between 155,000 and 145,000 lb, (1B) when ZFW is between 145,000 and 135,000 lb and (1C) when ZFW is 135,000 and less. Thus the shaded area between the V_{NO} lines may be available according to the ZFW of the particular flight. The almost vertical line (2) is assumed as the lower limit of economic crusing speed and this weight/altitude/speed relationship is used as the basis for long range cruise operation. The superimposed curved lines of constant weight (3) with altitude (4) comprise the available performance areas (5) and (6) (shaded). Area (5) is the normal operating region, extending from the long range procedure line (2) on the left, to the maximum speeds on the right. Area (6) to the left is shown for reference purposes to illustrate the spread between the normal climb speeds and the long range cruise speeds. While this area would be useful for low fuel flow endurance purposes, it is uneconomical for normal cruising operation.

It will be seen that for any weight within the normal operating range, an increase in altitude will increase the range but decrease TAS. Thus, if cruise climb operation were acceptable, minimum fuel for a given range would be achieved flying the long range cruise line (2); conversely, minimum time would be realized following the V_{NO} limit line in a slow cruise climb of 7 fpm.

The cruise grid illustrates performance in ISA. (International Standard Atmosphere) temperatures. In warmer temperatures, the performance area (5) encompasses lower altitudes due to engine power reduction, and conversely, at higher altitudes in cooler temperatures.

The cruise grid of Figure 1-1 was reproduced for illustrative purposes. Actual performance presented in this manual, was transformed from similar grids, to the tabular form, for ease and accuracy in regular usage.

C. It should be emphasized that the prime criterion is payload revenue which is of considerably greater value than the direct operating cost of the trip. In this regard, the cruising altitude should be selected such that enroute fuel requirements enable carrying the maximum possible payload. The appropriate Figure 1-5 to 1-7, depending upon the Zero Fuel Weight of the flight, should therefore be analysed, in conjunction with the forecast enroute winds and temperature anomly (variation from ISA) in order to determine the preferable altitude, based on the minimum trip fuel required. When a further reduction in trip fuel is necessary to accommodate payload, a long range cruise procedure should be used, as outlined in Paragraph 6.

When the required trip fuel would not interfere with the payload available, the minimum time procedure, at a lower flight level, may be performed.

The block speed for long range cruise is only in the order of 6 to 10 knots less than that for minimum time procedure.

D. Wind effects do not significantly influence the CL-44 cruise procedure in the usual operating region (5), at altitudes above those where serious V_{NO} limitations are encountered. Range increases in the order of 3-1/2% per 1,000 feet increase in altitude which would not be negated, unless the headwind component increased by 12 knots per 1,000 feet. Conversely, the same range would be attained at an altitude 1,000 feet lower than planned in the headwind component were reduced by 12 knots.

E. In consideration of minimum time operation, it will be noted that the TAS for a given weight will reduce at an average of approximately 2-1/2 knots per 1,000 feet increase of altitude. Thus when desiring minimum trip time, increased altitude would result in better ground speed only if the wind component reduces by more than 2-1/2 knots per 1,000 feet. On the other hand, lower altitudes where the V_{NO} limitations are encountered could be beneficial if the wind component reduces by more than 6 knots per 1,000 feet.

F. Over longer ranges, when specific altitudes are allotted, normal operation would include a step-climb. When the minimum-time procedure can be used (no payload restriction), the initial altitude should be selected, so that the V_{NO} speed is reached when the weight has reduced to the mid-cruise value, at which point, a step-climb is made to the higher altitude to avoid the V_{NO} restriction. The step-climb should be made at a constant rate of climb of 200 to 300 fpm with negligible effect on trip time and fuel planning. In an area where a change in altitude may not be approved, it may be preferable to seek a compromise level for the entire flight.

G. The maximum attainable cruise altitude will decrease by 1,000 feet per 5°C increase in ambient temperature when below ISA, and by 1,700 feet per 5°C increase when above ISA.

H. In passenger operation, at lower Zero Fuel Weights in the order of 135,000 lb or less, the higher design V_{NO} limit of 275 knots EAS (280/285 IAS) will not normally be restrictive, at normal altitudes.

I. At any altitude, the Tyne engine develops essentially constant power at ambient temperatures below ISA due to fuel flow regulation, corresponding to the turbine power limitation. At temperatures above ISA, the Turbine Entry Temperature controls the power developed, which decrease with increasing ambient temperature. This effect is reflected in speed performance at constant cruise altitude as follows:

(a) at ambient temperatures above ISA, a 5°C increase (or decrease) would reduce (or increase) TAS by 10 knots at 155,000 lb ZFW and by 7 knots at 135,000 lb ZFW.

(b) at ambient temperatures below ISA, a 5°C increase (or decrease) would result in a 1-1/2 knots increase (or decrease) at 155,000 lb and 2 knots at 135,000 lb.

J. Due to the compressibility effect, the indicated temperature reads warmer. To obtain the actual free air temperature subtract the values shown below (°C).

		CAS Kts	
Altitude (ft)	150	200	250
Sea Level	2	4	7
5,000	3	5	8
10,000	3	6	9
15,000	4	7	10
20,000	5	8	12
25,000	6	9	14
30,000	7	10	16

3. Weight, Speed and Fuel Limitations

The maximum design weights of the aircraft are as follows:

Maximum Take-off Weight	210,000 lb
Maximum Landing Weight	165,000 lb
Maximum Zero Fuel Weight	155,000 lb

The V_{NO} limited cruise speed of the CL-44, taken from the Flight Manual, is a function of Zero Fuel Weight as follows:

Zero Fuel Weight	Limit V_{NO} Knots, EAS	Approximate % Cargo Payload
Between 145,001 to 155,000 lb	250	85% to 100%
Between 135,001 to 145,000 lb	262	70% to 85%
135,000 lb and less	275	to 70%

The V_{NO} restriction would be encountered at lower altitudes, which should be avoided as uneconomic and increasing trip time.

The fuel management operation is stated in Section 2 of the Flight Manual.

The usable and unusable quantities of fuel to the nearest 5 lb are as follows:

	Without Centre Tank		With Centre Auxiliary Tank	
	Usable	Unusable	Usable	Unusable
U.S. Gal Capacity	10,172	177	12,154	188
Weights at				
6.9 lb/U.S. Gal	70,185	1,220	83,865	1,295
6.8 lb/U.S. Gal	69,170	1,205	82,645	1,280
6.7 lb/U.S. Gal	68,150	1,190	81,430	1,260
6.6 lb/U.S. Gal	67,135	1,170	80,215	1,240
6.5 lb/U.S. Gal	66,120	1,150	79,000	1,220
6.4 lb/U.S. Gal	65,100	1,135	77,785	1,205

4. Flight Analysis and Flight Planning

The flight planning system consists of two phases:

A. The Analysis

B. The Flight Plan

The Analysis determines:

(1) Whether the flight can take place at all.

(2) Which alternates will be used.

(3) What track, altitude and speed will be selected to avoid restriction of payload.

(4) What payload limitations, if any, exist.

The Flight Plan is a detailed plan for the conduct of the flight, sector by sector.

A schematic drawing of the comprehensive decision analyses required is shown in Figure 1-1A.

As an aid in the initial evaluation of the most suitable altitude, fuel required and take-off weight; the flight fuel is indicated as a function of Zero Fuel Weight in Figures 1-5, 1-6 and 1-7.

Ramp Weight would be greater than take-off by the amount of fuel used prior to take-off. This varies at different bases and with the policy of each operator The following is presented as an example of the fuel weight used prior to take-off.

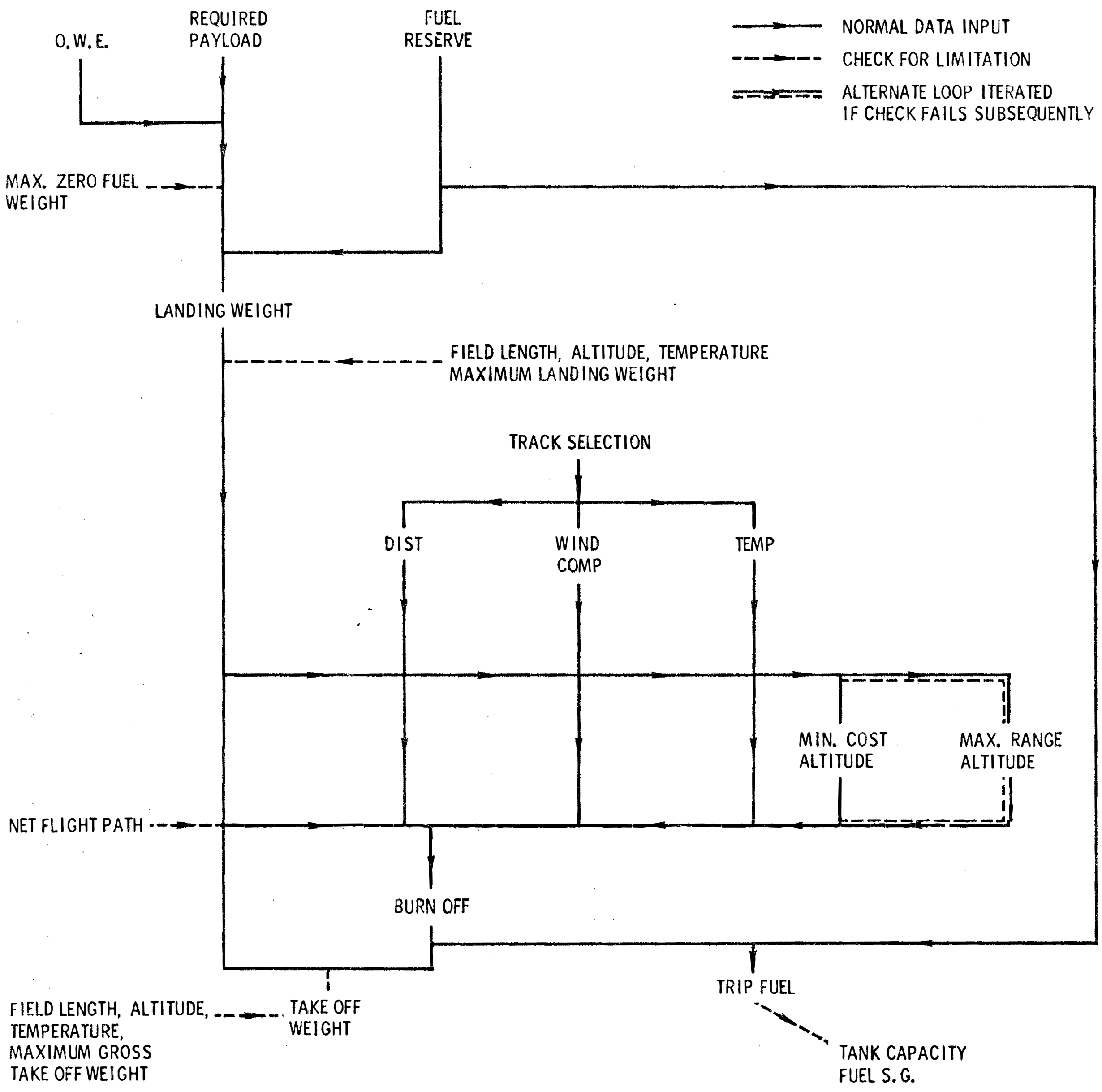
10 minutes ground idle at 46 lb/min = 460 lb

1 minute take-off power = 170 lb

Total pre-take-off fuel = 630 lb

The Flight Manual contains all certification performance data, and must be consulted regarding possible limitations pertaining to specific flights.

SCHEMATIC OF FLIGHT ANALYSIS



44D4-OM-5-4

Schematic of Flight Analysis
Figure 1-1A

5. Cruise Altitude for Minimum Cost

The cruise altitude for minimum cost is essentially determined by the relationship between trip fuel cost and those elements which are directly related to time. Company policy may emphasize reduced block time operation, having special consideration for reduced engine time, maintenance time, increased flights capability etc, when payload is not restricted.

Minimum time operation at higher Zero Fuel Weights would normally terminat at the altitude where V_{NO} would be limiting only at final weight,. having performed an intermediate step-climb from a lower initial altitude. The exact altitude for minimum cost would be normally one to three thousand feet higher.

However the choice is purely that of operator's preference, since the CL-44 is quite flexible economically. A variation of only 1/2% in Direct Operating Cost per mile, would be shown, through an altitude band of 3, 000 feet.

The Direct Operating Cost per mile increases approximately 1% for 2-1/2°C rise in ambient temperature or for 3-1/2 knots of headwind.

The operation should be flown at recommended cruise rpm of 88.5% and will therefore make use of data in pages 2.11 and following.

The following table will serve as a guide for selection of the proper initial cruise altitude for economical minimum trip time procedure.

	Take-off Gross Weight x 1000#			
Enroute	ZFW 155, 000 #		ZFW 135, 000 #	
Temperature	210/185	185/165	210/185	185/165
ISA - 30°C	23, 000	25, 000	19, 000	23, 000
ISA - 20°C	22, 000	24, 000	18, 000	22, 000
ISA - 10°C	21, 000	23, 000	17, 000	21, 000
ISA	19, 000	21, 000	15, 000	19, 000
ISA + 10°C	15, 000	17, 000	13, 000	17, 000
ISA + 20°C	12, 000	14, 000	11, 000	15, 000

6. Cruise Altitude for Maximum Range

Maximum range is attained at maximum recommended cruise rpm at the highest altitude. Where a choice exists between maintaining a lower altitude at reduced rpm, or a higher altitude at recommended cruise rpm of 88.5% the higher altitude should be selected, for best range.

If cruise climb technique is not usable, step climbs should be conducted for maximum range. With enroute normal fuel consumption approximating 5, 000 lb per hour, and attainable cruise altitude varying by 1, 000 feet per 5, 000 lb change in weight, the steps would then be planned with hours elapsed at each altitude, dependent upon the number of 1, 000-foot increments in the altitude steps; that is, two thousand foot altitude steps would entail a minimum of two hours at each altitude.

For maximum range operation, the initial cruise altitude, obtained from Figure 1-2 would be as follows;

Ambient	Take-off Weight	
Temperature	210, 000 lb	205, 000 lb
ISA - 30°C	24, 000	25, 000
ISA - 20°C	24, 000	25, 000
ISA - 10°C	23, 000	24, 000
ISA	20, 000	21, 000
ISA + 10°C	17, 000	18, 000
ISA + 20°C	13, 000	14, 000

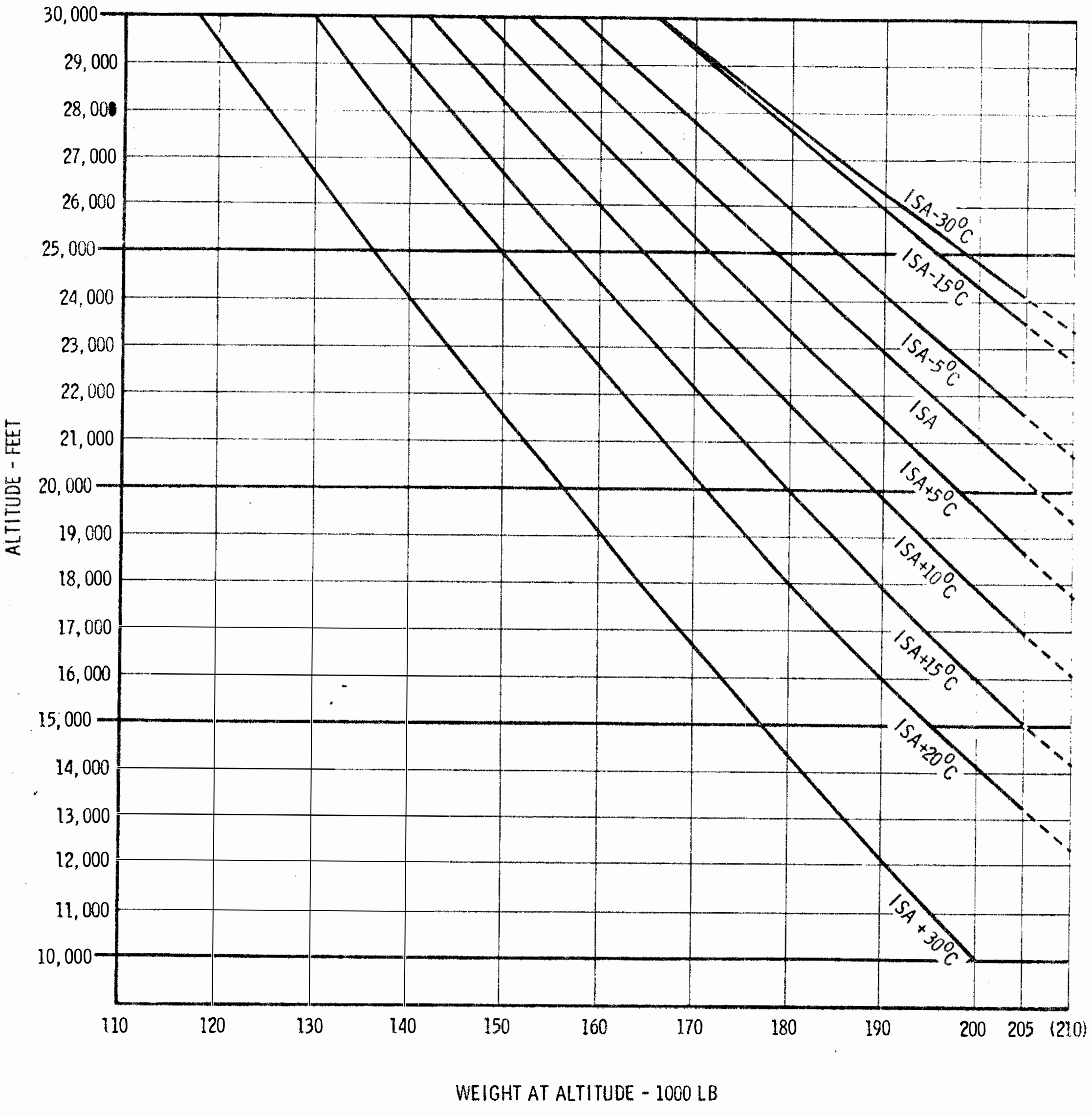
7. Maximum Cruise Altitude

The following graphs, Figures 1-2, 1-2A, 1-3 and 1-4, indicate the attainable cruise altitudes as a function of aircraft weight at altitude, for various temperature anomalies. They correspond to the minimum cruise speed at the recommended rpm, as follows:

Figure 1-2 Four Engines	88.5% rpm (13,500) and 1164°K
Figure 1-2A Three Engines	88.5% rpm (13,500) and 1164°K
Figure 1-3 Three Engines	95.1% rpm (14,500)
Figure 1-4 Two Engines	95.1% rpm (14,500)

MAXIMUM CRUISE ALTITUDE

4 ENGINES AT 88.5% LPRPM - 1164°K

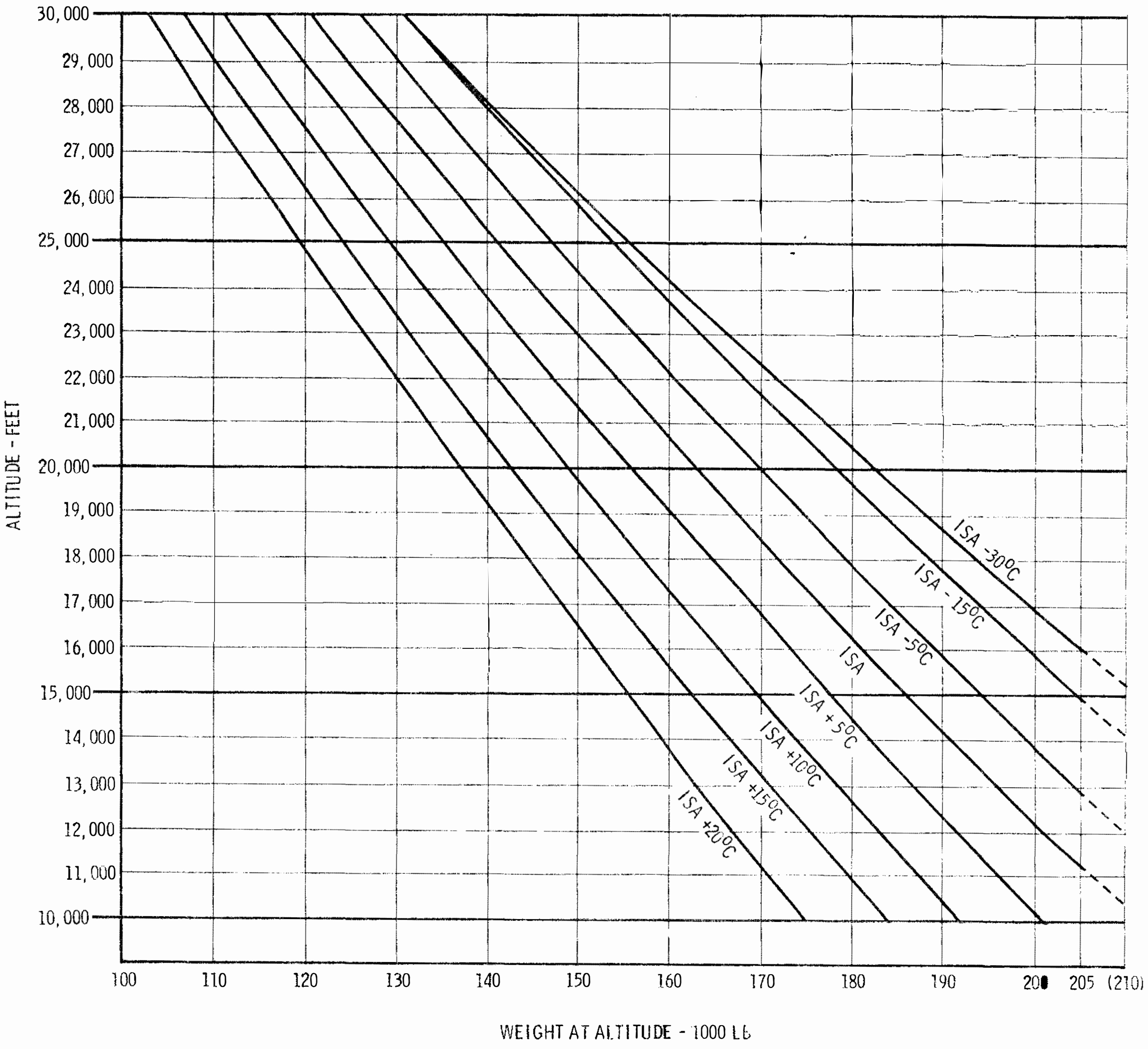


44D4-OM-5-1B

Maximum Cruise Altitude - Four Engines 88.5% RPM
Figure 1-2

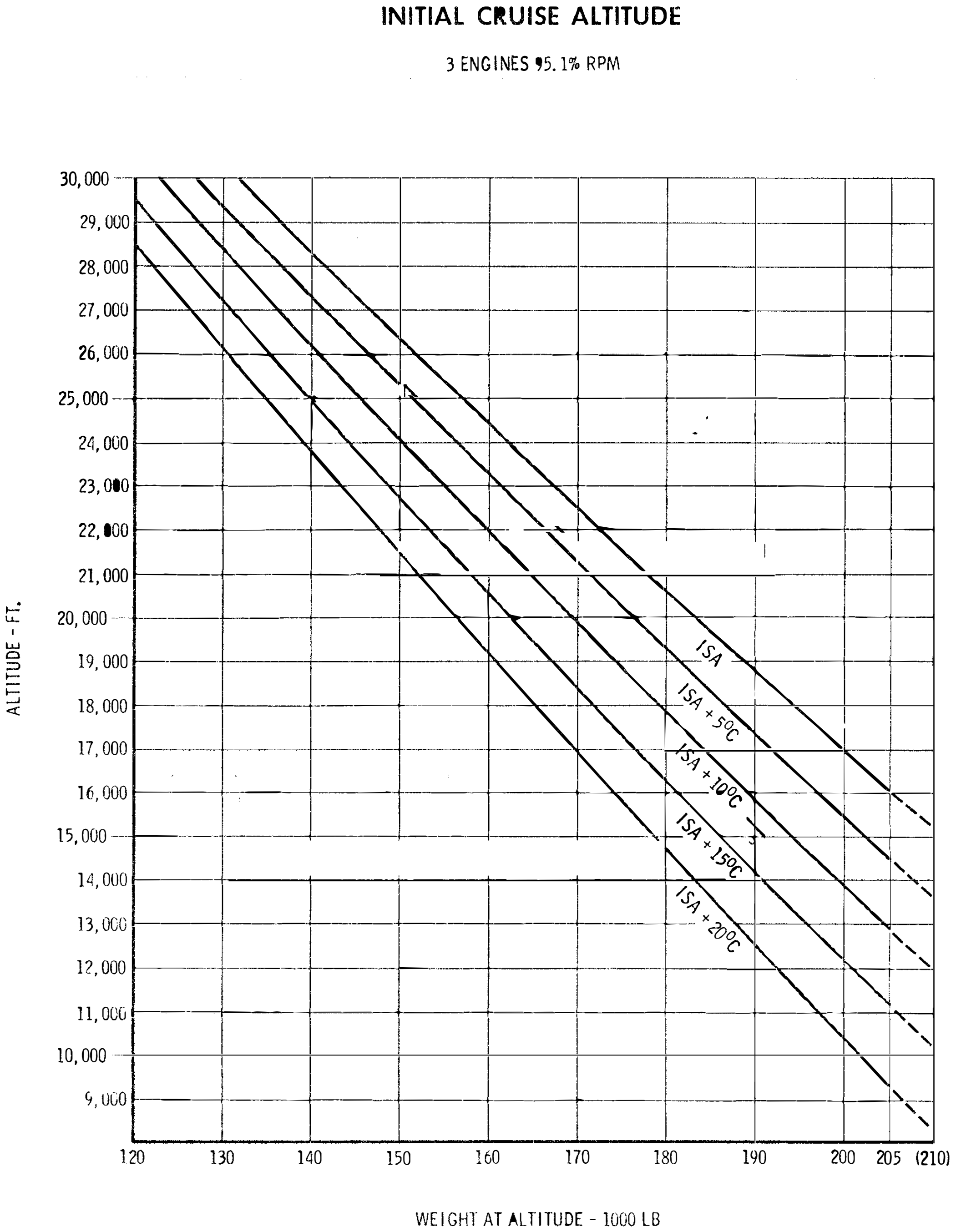
MAXIMUM CRUISE ALTITUDE

3 ENGINES AT 88.5% LPRPM - 1164°K



44D4-OM-5-18

Maximum Cruise Altitude - Three Engines 88.5% RPM
Figure 1-2A

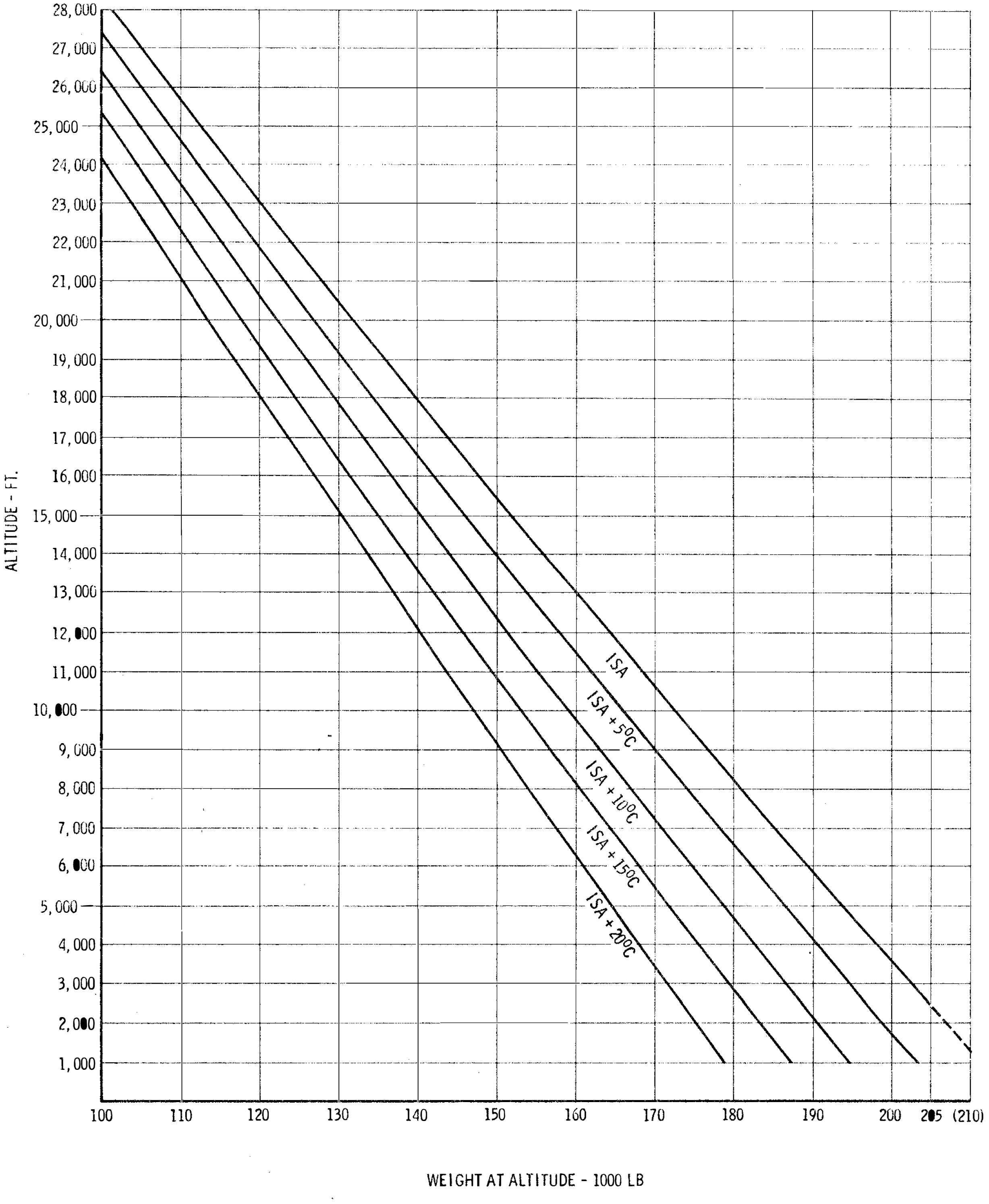


44D4-OM-5-2

Initial Cruise Altitude - Three Engines 95.1% RPM
Figure 1-3

INITIAL CRUISE ALTITUDE

2 ENGINES 95.1% RPM



44D4-OM-5-3

Initial Cruise Altitude - Two Engines 95.1 % RPM
Figure 1-4

8. Fuel Reserves

The fuel reserves must be determined by the operator in accordance with the applicable regulations and their particular company policy.

Diversion fuel requirements including climb back from sea-level are shown on page 2. 87.

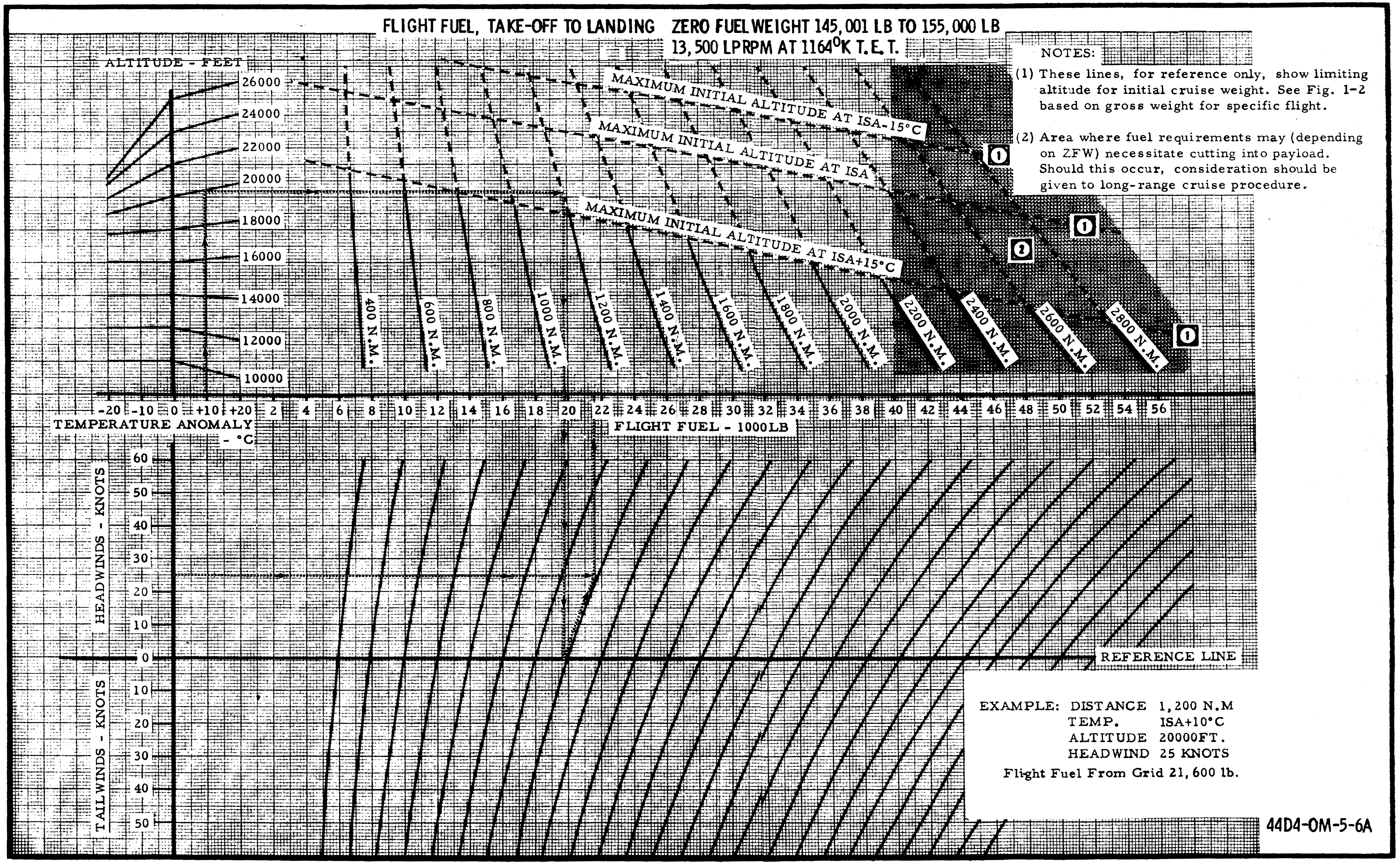
For information purposes minimum fuel consumption is shown on page 2. 86 at the speed for long range procedure.

9. Flight Fuel, Take-off to Landing

The flight fuel required for normal four engine operation at 88.5% rpm and 1164°K are presented in the following Figures 1-5, 1-6 and 1-7, for the three main Zero Fuel Weights. Corrections for wind and temperature are included.

This data includes fuel for climb, cruise and normal descent, the latter initiated at the distance from destination as indicated in the Descent Table, page 2.85.

To present realistic and least optimistic data, the computations were made for the higher Zero Fuel Weight shown, with 10,000 lb fuel reserves. For this weight configuration, the shaded portion serves as a reminder that payload may be limited when the flight plan fuel exceeds 40,000 lb, at the full 205,000 lb take-off weight, or with 45,000 lb of fuel at the 210,000 lb take-off weight.



FLIGHT FUEL, TAKE-OFF TO LANDING ZERO FUELWEIGHT 145,001 LB TO 155,000 LB
13,500 LPRPM AT 1164°K T.E.T.

NOTES:

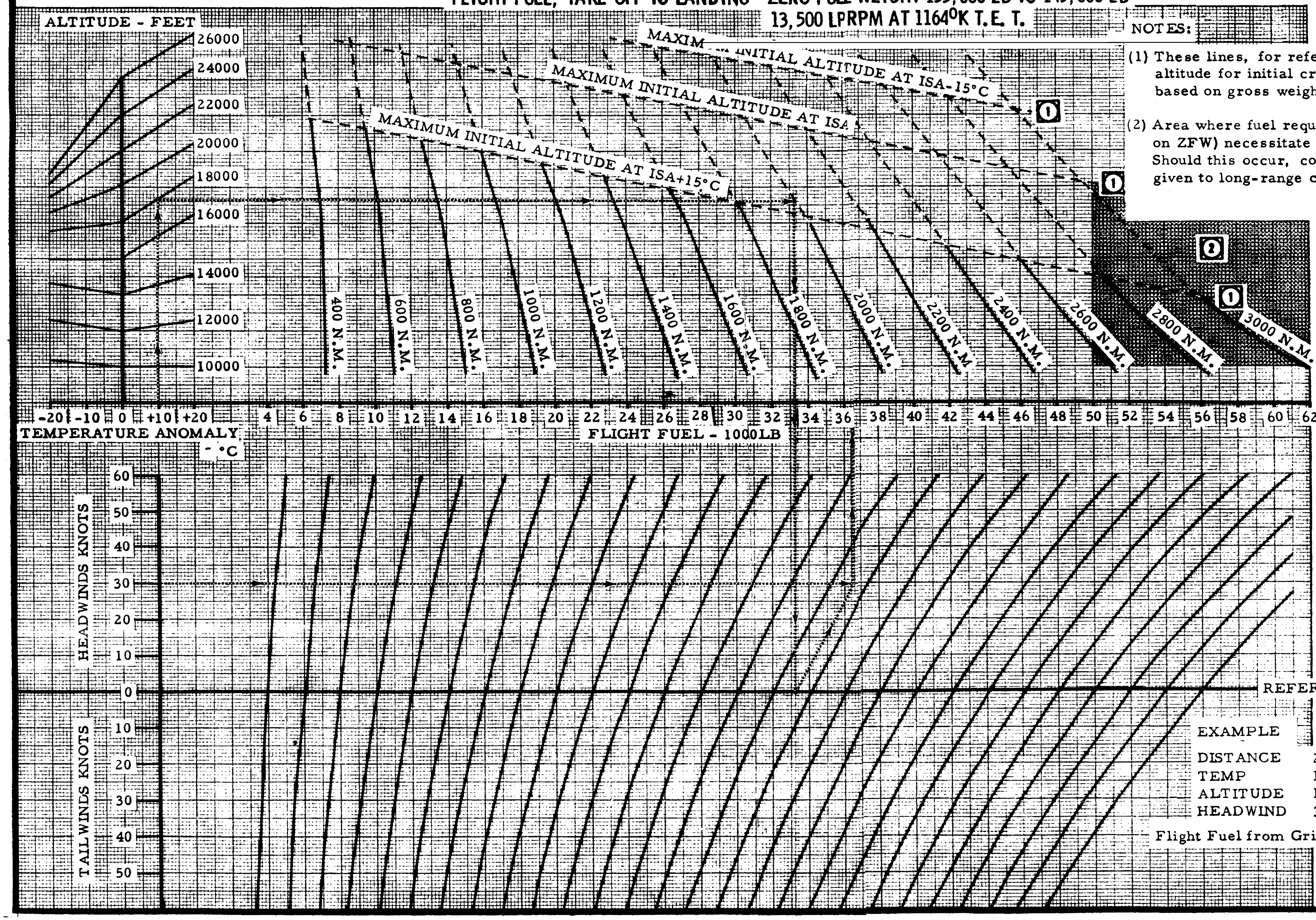
(1) These lines, for reference only, show limiting altitude for initial cruise weight. See Fig. 1-2 based on gross weight for specific flight.

(2) Area where fuel requirements may (depending on ZFW) necessitate cutting into payload. Should this occur, consideration should be given to long-range cruise procedure.

EXAMPLE: DISTANCE 1,200 N.M
TEMP. ISA+10°C
ALTITUDE 20000FT.
HEADWIND 25 KNOTS
Flight Fuel From Grid 21,600 lb.

Flight Fuel, Take-off to Landing, Z.F.W. 155,000 lb
Figure 1-5

FLIGHT FUEL, TAKE-OFF TO LANDING ZERO FUEL WEIGHT 135,000 LB TO 145,000 LB
13,500 LPRPM AT 1164°K T.E.T.



NOTES:

(1) These lines, for reference only, show limiting altitude for initial cruise weight. See Fig. 1-2 based on gross weight for specific flight.

(2) Area where fuel requirements may (depending on ZFW) necessitate cutting into payload. Should this occur, consideration should be given to long-range cruise procedure.

EXAMPLE

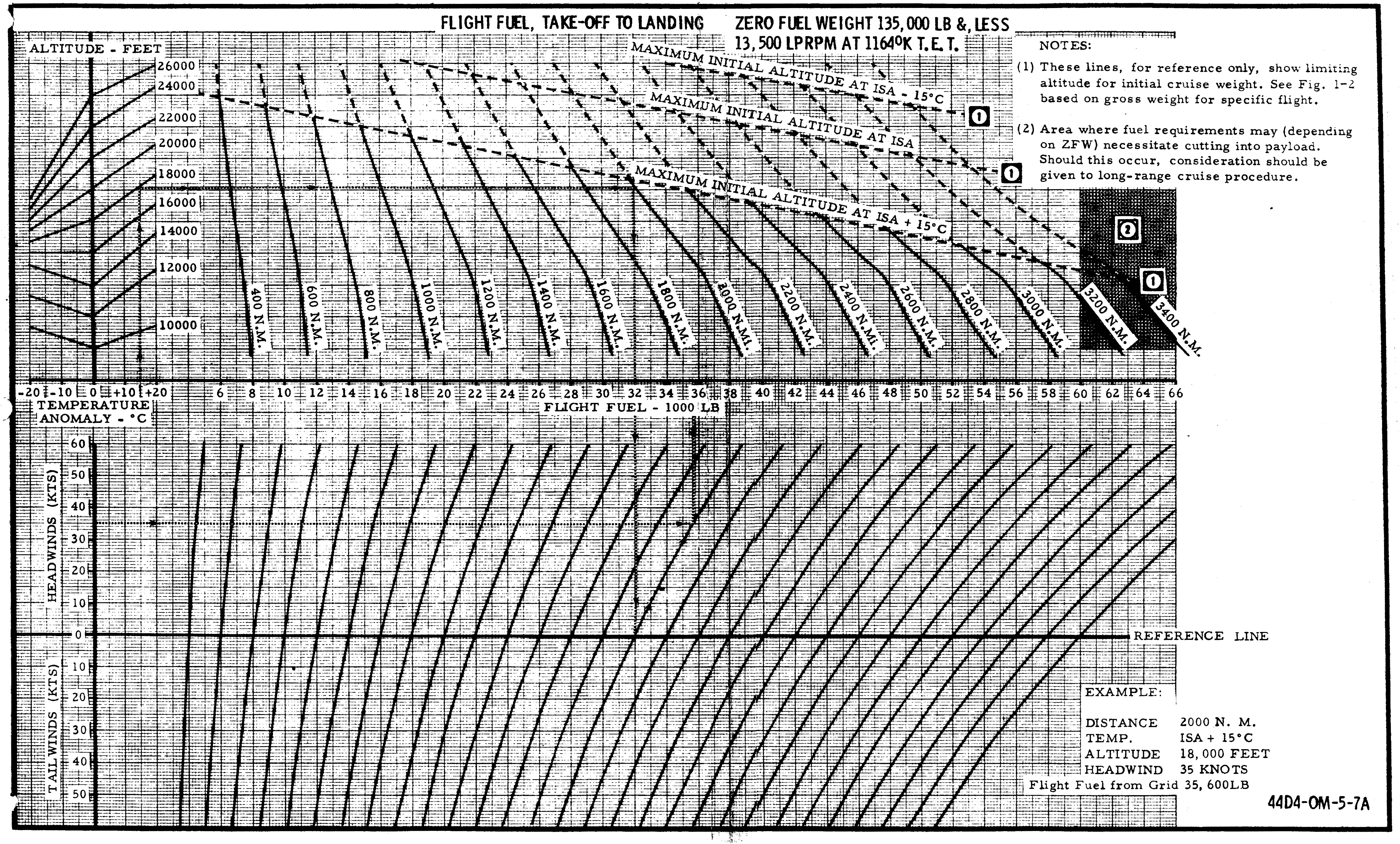
DISTANCE	2000 N.M.
TEMP	ISA+10°C
ALTITUDE	18,000 FEET
HEADWIND	30 KNOTS

Flight Fuel from Grid 36,400LB.

44D4-OM-5-13A

Flight Fuel, Take-off to Landing, Z.F.W. 145,000 lb
Figure 1-6

FLIGHT FUEL, TAKE-OFF TO LANDING ZERO FUEL WEIGHT 135,000 LB &, LESS 13,500 LPRPM AT 1164°K T.E.T.



NOTES:

(1) These lines, for reference only, show limiting altitude for initial cruise weight. See Fig. 1-2 based on gross weight for specific flight.

(2) Area where fuel requirements may (depending on ZFW) necessitate cutting into payload. Should this occur, consideration should be given to long-range cruise procedure.

EXAMPLE:

DISTANCE	2000 N. M.
TEMP.	ISA + 15°C
ALTITUDE	18,000 FEET
HEADWIND	35 KNOTS

Flight Fuel from Grid 35, 600LB

Flight Fuel, Take-off to Landing, Z.F.W. 135,000 lb
Figure 1-7

SECTION 5

PART 2

1. Four Engine Climb

The four engine climb is conducted at 88.5% LP rpm (13,500) and 1164° K Turbine Entry Temperature.

Eight tabular charts, Pages 2.2 to 2.9, are presented and are arranged in terms of prevailing temperature anomaly, namely:

ISA - 30° C
ISA - 15° C
ISA - 5° C
ISA
ISA + 5° C
ISA + 10° C
ISA + 15° C
ISA + 20° C

On each chart, as a function of take-off weight and pressure altitude attained, the following information is presented:

TAS, Average true airspeed during climb, knots.
FUEL, Fuel consumed in climbing to altitude, pounds.
TIME, Elapsed time, take-off to altitude, Hours: Minutes.

In addition, the Indicated Airspeed that will be maintained, is shown as a function of weight.

The appropriate climb chart to be used, will be that corresponding to the average temperature anomaly existing between the airport elevation and the initial cruise altitude.

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K & 1180°K)

30°C
BELOW
STANDARD
TEMPERATURE

TAKE OFF GROSS WEIGHT (1000#)		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE TRUE OAT °C	IAS KNOTS	205	203	200	195	190	184	179	173	167	161	156	148
27,000'	TAS Kts.				242	233	225	217	208	201	193	184	176
	FUEL #				3, 860	3, 170	2, 690	2, 320	2, 020	1, 770	1, 550	1, 370	1, 210
-57	TIME HR. Min.				0:39	0:31	0:26	0:23	0:20	0:17	0:15	0:13	0:12
25,000'	TAS Kts.	249	243	240	232	225	217	210	202	195	187	179	171
	FUEL #	4, 730	4, 250	3, 770	3, 150	2, 690	2, 330	2, 030	1, 790	1, 580	1, 400	1, 240	1, 100
-57	TIME HR. Min.	0:46	0:41	0:36	0:30	0:25	0:22	0:19	0:17	0:15	0:13	0:12	0:10
23,000'	TAS Kts.	243	238	236	228	221	214	207	200	193	185	177	169
	FUEL #	4, 130	3, 750	3, 410	2, 890	2, 490	2, 170	1, 910	1, 690	1, 500	1, 330	1, 180	1, 050
-57	TIME HR. Min.	0:39	0:35	0:32	0:27	0:23	0:20	0:18	0:16	0:14	0:12	0:11	0:10
22,000'	TAS Kts.	239	236	232	225	218	211	205	197	190	183	175	167
	FUEL #	3, 690	3, 360	3, 110	2, 670	2, 320	2, 040	1, 800	1, 590	1, 420	1, 260	1, 130	1, 060
-57	TIME HR. Min.	0:34	0:31	0:28	0:24	0:21	0:18	0:16	0:14	0:13	0:11	0:10	0:09
21, 000'	TAS Kts.	235	232	229	222	215	209	202	195	188	181	173	165
	FUEL #	3, 340	3, 060	2, 850	2, 470	2, 160	1, 910	1, 690	1, 500	1, 340	1, 200	1, 070	950
-57	TIME HR. Min.	0:30	0:28	0:26	0:22	0:19	0:17	0:15	0:13	0:12	0:11	0:10	0:09
20, 000'	TAS Kts.	232	229	226	220	213	206	200	193	186	179	171	163
	FUEL #	3, 050	2, 830	2, 630	2, 290	2, 020	1, 790	1, 590	1, 420	1, 270	1, 130	1, 010	900
-55	TIME HR. Min.	0:27	0:25	0:23	0:20	0:18	0:16	0:14	0:12	0:11	0:10	0:09	0:08
19, 000'	TAS Kts.	229	226	223	217	210	204	198	191	184	177	170	162
	FUEL #	2, 800	2, 600	2, 430	2, 130	1, 880	1, 670	1, 490	1, 330	1, 190	1, 070	960	860
-53	TIME HR. Min.	0:24	0:23	0:21	0:18	0:16	0:14	0:13	0:1 2	0:10	0:09	0:08	0:07
18, 000'	TAS Kts.	226	223	220	214	208	202	196	189	182	175	168	160
	FUEL #	2, 570	2, 400	2, 250	1, 980	1, 760	1, 570	1, 400	1, 250	1, 120	1, 010	900	810
-51	TIME HR. Min.	0:22	0:21	0:19	0:17	0:15	0:13	0:12	0:11	0:10	0:09	0:08	0:07
17, 000'	TAS Kts.	224	221	218	212	206	200	194	187	181	174	166	159
	FUEL #	2, 370	2, 220	2, 080	1, 840	1, 640	1, 460	1, 310	1, 180	1, 060	950	850	760
-49	TIME HR. Min.	0:20	0:19	0:17	0:1 5	0:14	0:12	0:11	0:10	0:09	0:08	0:07	0:06
16, 000'	TAS Kts.	221	219	216	210	204	198	192	186	179	172	165	157
	FUEL #	2, 180	2, 050	1, 920	1, 710	1, 520	1, 360	1, 220	1, 100	1, 000	890	800	720
-47	TIME HR. Min.	0:18	0:17	0:16	0:1 4	0:13	0:11	0:10	0:09	0:08	0:07	0:07	0:06
15, 000'	TAS Kts.	219	217	214	208	202	196	190	184	177	170	163	156
	FUEL #	2, 000	1, 890	1, 770	1, 580	1, 410	1, 260	1, 140	1, 020	920	830	750	670
-45	TIME HR. Min.	0:16	0:15	0:14	0:13	0:12	0:10	0:09	0:08	0:08	0:07	0:06	0:06
14, 000'	TAS Kts.	217	216	212	206	200	195	189	182	175	169	162	154
	FUEL #	1, 840	1, 740	1, 630	1, 460	1, 310	1, 170	1, 060	950	860	770	700	630
-43	TIME HR. Min.	0:15	0:14	0:13	0:12	0:11	0:09	0:09	0:08	0:07	0:06	0:06	0:05
12, 000'	TAS Kts.	213	213	208	203	198	192	186	180	173	167	159	152
	FUEL #	1, 530	1, 440	1, 370	1, 230	1, 1 00	990	900	810	730	660	600	540
-39	TIME HR. Min.	0:12	0:11	0:11	0:10	0:09	0:08	0:07	0:06	0:06	0:05	0:05	0:04
10, 000'	TAS Kts.	210	208	205	200	195	189	183	177	170	164	157	149
	FUEL #	1, 250	1, 1 80	1, 120	1, 010	910	820	740	670	610	550	500	450
-35	TIME HR. Min.	0:10	0:09	0:09	0:08	0:07	0:06	0:06	0:05	0:05	0:04	0:04	0:03

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K & 1180°K)

15°C
BELOW
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT (1000#)		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE TRUE OAT °C	IAS KNOTS	205	203	200	195	190	184	179	173	167	161	156	148
26,000' -52	TAS Kts.				249	240	231	223	215	206	198	190	181
	FUEL #				4,120	3,340	2,800	2,400	2,080	1,810	1,590	1,400	1,240
	TIME HR. Min.				0:41	0:33	0:27	0:23	0:20	0:18	0:15	0:14	0:12
24,000' -48	TAS Kts.		254	248	240	232	224	217	209	201	193	185	176
	FUEL #		4,650	4,100	3,350	2,830	2,430	2,110	1,850	1,630	1,440	1,270	1,130
	TIME HR. Min.		0:45	0:39	0:32	0:27	0:23	0:20	0:17	0:15	0:13	0:12	0:11
23,000' -46	TAS Kts.	252	248	244	236	229	221	214	206	199	191	183	174
	FUEL #	4,570	4,100	3,680	3,070	2,620	2,270	1,980	1,740	1,540	1,370	1,210	1,080
	TIME HR. Min.	0:43	0:39	0:34	0:29	0:24	0:21	0:18	0:16	0:14	0:13	0:11	0:10
22,000' -44	TAS Kts.	248	244	240	233	226	218	211	204	196	189	181	172
	FUEL #	4,050	3,650	3,340	2,830	2,440	2,130	1,870	1,650	1,460	1,300	1,150	1,020
	TIME HR. Min.	0:37	0:34	0:31	0:26	0:22	0:19	0:17	0:15	0:13	0:12	0:10	0:09
21,000' -42	TAS Kts.	244	240	236	230	223	216	209	202	194	187	179	171
	FUEL #	3,640	3,310	3,060	2,620	2,270	1,990	1,750	1,550	1,380	1,230	1,090	1,000
	TIME HR. Min.	0:33	0:30	0:27	0:23	0:20	0:18	0:16	0:14	0:12	0:11	0:10	0:09
20,000' -40	TAS Kts.	240	238	233	227	220	213	206	199	192	185	177	169
	FUEL #	3,300	3,050	2,810	2,430	2,120	1,860	1,650	1,460	1,300	1,160	1,040	920
	TIME HR. Min.	0:29	0:27	0:25	0:21	0:19	0:16	0:14	0:13	0:11	0:10	0:09	0:08
19,000' -38	TAS Kts.	237	235	230	224	218	211	204	197	190	183	175	167
	FUEL #	3,010	2,800	2,590	2,250	1,970	1,740	1,550	1,380	1,230	1,100	980	880
	TIME HR. Min.	0:26	0:24	0:22	0:19	0:17	0:15	0:13	0:12	0:11	0:10	0:09	0:08
18,000' -36	TAS Kts.	234	232	228	221	215	209	202	195	188	181	173	165
	FUEL #	2,760	2,550	2,390	2,090	1,840	1,630	1,450	1,290	1,160	1,030	930	830
	TIME HR. Min.	0:24	0:22	0:20	0:18	0:16	0:14	0:12	0:11	0:10	0:09	0:08	0:07
17,000' -34	TAS Kts.	231	228	225	219	213	206	200	193	186	179	172	164
	FUEL #	2,530	2,350	2,200	1,930	1,710	1,520	1,350	1,210	1,080	970	870	780
	TIME HR. Min.	0:21	0:20	0:18	0:16	0:14	0:13	0:11	0:10	0:09	0:08	0:07	0:07
16,000' -32	TAS Kts.	229	227	223	217	211	204	198	191	185	177	170	162
	FUEL #	2,310	2,160	2,030	1,790	1,590	1,410	1,260	1,130	1,010	910	820	730
	TIME HR. Min.	0:19	0:18	0:17	0:15	0:13	0:12	0:10	0:09	0:08	0:08	0:07	0:06
15,000' -30	TAS Kts.	226	224	220	214	208	202	196	189	183	176	168	160
	FUEL #	2,120	1,990	1,860	1,650	1,470	1,310	1,170	1,050	950	850	760	690
	TIME HR. Min.	0:17	0:16	0:15	0:13	0:12	0:11	0:10	0:09	0:08	0:07	0:06	0:06
14,000' -28	TAS Kts.	224	222	218	212	206	200	194	188	181	174	167	159
	FUEL #	1,940	1,810	1,710	1,520	1,350	1,210	1,090	1,000	900	800	710	640
	TIME HR. Min.	0:16	0:15	0:14	0:12	0:11	0:10	0:09	0:08	0:07	0:06	0:06	0:05
12,000' -24	TAS Kts.	219	217	214	209	203	197	191	184	178	171	164	156
	FUEL #	1,600	1,510	1,420	1,270	1,140	1,020	920	830	750	670	610	550
	TIME HR. Min.	0:13	0:12	0:11	0:10	0:09	0:08	0:07	0:07	0:06	0:05	0:05	0:04
10,000' -20	TAS Kts.	215	212	210	205	199	193	187	181	175	168	161	153
	FUEL #	1,300	1,220	1,160	1,040	930	840	760	690	620	560	510	460
	TIME HR. Min.	0:10	0:10	0:09	0:08	0:07	0:06	0:06	0:05	0:05	0:04	0:04	0:04

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K)

5°C
BELOW
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT (1000#)		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE TRUE OAT °C	IAS KNOTS	205	203	200	195	190	184	179	173	167	161	156	148
24,000' -38	TAS Kts.			261	250	239	231	222	214	206	197	189	180
	FUEL #			6,180	4,060	3,150	2,640	2,250	1,910	1,660	1,490	1,300	1,150
	TIME HR. Min.			0:56	0:40	0:32	0:26	0:22	0:19	0:16	0:14	0:12	0:11
23,000' -36	TAS Kts.		255	251	241	235	227	219	212	205	195	187	178
	FUEL #		5,680	4,710	3,460	2,850	2,360	2,090	1,840	1,590	1,420	1,240	1,100
	TIME HR. Min.		0:52	0:45	0:35	0:28	0:24	0:20	0:17	0:15	0:13	0:12	0:10
22,000' -34	TAS Kts.	256	251	246	238	230	223	216	208	201	193	185	177
	FUEL #	5,790	4,700	4,080	3,300	2,680	2,310	2,000	1,720	1,530	1,330	1,170	1,040
	TIME HR. Min.	0:50	0:43	0:38	0:30	0:25	0:21	0:18	0:16	0:14	0:12	0:11	0:10
21,000' -32	TAS Kts.	252	247	243	234	228	220	214	206	200	191	183	175
	FUEL #	4,450	3,980	3,530	2,860	2,480	2,150	1,870	1,600	1,420	1,270	1,140	1,000
	TIME HR. Min.	0:43	0:37	0:32	0:27	0:23	0:19	0:17	0:14	0:13	0:11	0:10	0:09
20,000' -30	TAS Kts.	248	244	240	233	226	219	213	205	198	190	181	173
	FUEL #	4,040	3,550	3,160	2,640	2,230	1,950	1,710	1,510	1,350	1,200	1,050	950
	TIME HR. Min.	0:34	0:31	0:27	0:23	0:20	0:18	0:15	0:14	0:12	0:11	0:10	0:08
19,000' -28	TAS Kts.	243	240	235	229	223	217	210	202	195	187	180	171
	FUEL #	3,600	3,250	2,850	2,420	2,070	1,850	1,650	1,440	1,270	1,140	1,000	900
	TIME HR. Min.	0:32	0:29	0:26	0:22	0:18	0:16	0:14	0:13	0:11	0:10	0:09	0:08
18,000' -26	TAS Kts.	240	237	233	226	220	213	206	199	192	184	177	169
	FUEL #	3,090	2,800	2,570	2,200	1,920	1,710	1,520	1,330	1,180	1,040	930	840
	TIME HR. Min.	0:27	0:24	0:23	0:19	0:17	0:15	0:14	0:12	0:10	0:09	0:08	0:07
17,000' -24	TAS Kts.	237	234	230	224	217	211	204	198	190	183	175	168
	FUEL #	2,750	2,520	2,350	2,020	1,780	1,550	1,410	1,250	1,140	1,000	900	810
	TIME HR. Min.	0:25	0:23	0:21	0:18	0:15	0:14	0:12	0:11	0:10	0:09	0:08	0:07
16,000' -22	TAS Kts.	234	231	227	220	215	207	201	194	188	180	172	165
	FUEL #	2,570	2,350	2,160	1,830	1,640	1,450	1,280	1,150	1,040	930	830	740
	TIME HR. Min.	0:21	0:19	0:18	0:16	0:14	0:13	0:12	0:10	0:09	0:08	0:07	0:06
15,000' -20	TAS Kts.	231	228	225	219	213	206	200	193	187	179	172	164
	FUEL #	2,290	2,120	1,970	1,740	1,560	1,380	1,250	1,120	1,000	900	800	700
	TIME HR. Min.	0:20	0:18	0:16	0:15	0:13	0:11	0:10	0:09	0:08	0:07	0:06	0:06
14,000' -18	TAS Kts.	228	225	222	217	211	205	199	192	185	178	170	162
	FUEL #	2,060	1,940	1,800	1,550	1,410	1,260	1,140	1,010	900	780	700	640
	TIME HR. Min.	0:17	0:16	0:15	0:13	0:12	0:11	0:10	0:08	0:08	0:07	0:06	0:05
13,000' -16	TAS Kts.	226	223	220	214	208	202	196	190	183	176	169	161
	FUEL #	1,860	1,750	1,670	1,460	1,270	1,150	1,040	920	840	750	670	600
	TIME HR. Min.	0:15	0:14	0:14	0:12	0:11	0:10	0:09	0:08	0:07	0:06	0:06	0:05
12,000' -14	TAS Kts.	224	221	218	212	206	200	194	188	182	175	168	159
	FUEL #	1,660	1,560	1,470	1,340	1,190	1,060	960	850	750	660	600	550
	TIME HR. Min.	0:14	0:13	0:12	0:11	0:10	0:09	0:08	0:07	0:06	0:06	0:05	0:05
10,000' -10	TAS Kts.	221	217	214	208	203	196	189	183	178	170	164	156
	FUEL #	1,330	1,260	1,210	1,080	970	900	810	730	640	560	500	440
	TIME HR. Min.	0:11	0:10	0:09	0:09	0:08	0:07	0:06	0:05	0:05	0:04	0:04	0:04

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K)

STANDARD TEMPERATURE

TAKEOFF GROSS WEIGHT (1000#) ⇨		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE TRUE OAT °C	IAS KNOTS ⇨	205	203	200	195	190	184	179	173	167	161	156	148
24,000' -33	TAS Kts.				252	242	233	225	216	208	199	191	182
	FUEL #				4,500	3,500	2,880	2,450	2,070	1,780	1,550	1,360	1,180
	TIME HR. Min.				0:44	0:36	0:29	0:25	0:21	0:18	0:16	0:13	0:12
23,000' -31	TAS Kts.				247	238	230	222	214	206	197	189	180
	FUEL #				3,950	3,180	2,610	2,240	1,950	1,680	1,470	1,290	1,130
	TIME HR. Min.				0:40	0:32	0:26	0:22	0:19	0:16	0:14	0:12	0:11
22,000' -29	TAS Kts.			251	242	234	226	218	211	203	195	187	178
	FUEL #			4,500	3,580	2,910	2,500	2,140	1,840	1,600	1,400	1,210	1,070
	TIME HR. Min.			0:45	0:35	0:29	0:24	0:20	0:18	0:15	0:13	0:12	0:10
21,000' -27	TAS Kts.		251	246	238	230	223	216	208	201	193	185	176
	FUEL #		4,420	3,970	3,210	2,690	2,300	1,960	1,710	1,500	1,320	1,170	1,040
	TIME HR. Min.		0:43	0:38	0:31	0:25	0:22	0:18	0:16	0:14	0:12	0:11	0:10
20,000' -25	TAS Kts.	251	247	243	235	228	221	215	207	199	191	183	175
	FUEL #	4,460	3,920	3,530	2,920	2,460	2,100	1,830	1,590	1,400	1,250	1,100	960
	TIME HR. Min.	0:43	0:38	0:33	0:27	0:23	0:20	0:17	0:15	0:13	0:12	0:10	0:09
19,000' -23	TAS Kts.	246	243	239	232	225	219	211	204	197	189	181	173
	FUEL #	3,920	3,540	3,200	2,680	2,280	1,980	1,720	1,500	1,340	1,170	1,040	910
	TIME HR. Min.	0:37	0:33	0:30	0:25	0:21	0:18	0:16	0:14	0:12	0:11	0:10	0:08
18,000' -21	TAS Kts.	243	239	236	229	222	215	208	201	194	186	179	170
	FUEL #	3,500	3,160	2,890	2,450	2,100	1,850	1,600	1,400	1,250	1,100	970	850
	TIME HR. Min.	0:32	0:29	0:26	0:22	0:19	0:17	0:15	0:13	0:11	0:10	0:09	0:08
17,000' -19	TAS Kts.	240	237	233	227	220	213	207	200	192	185	177	169
	FUEL #	3,140	2,860	2,630	2,240	1,920	1,680	1,500	1,310	1,170	1,040	930	820
	TIME HR. Min.	0:28	0:26	0:24	0:20	0:17	0:15	0:13	0:12	0:10	0:09	0:08	0:07
16,000' -17	TAS Kts.	237	233	230	223	217	210	203	197	190	183	175	167
	FUEL #	2,830	2,600	2,400	2,060	1,790	1,550	1,360	1,200	1,080	960	850	760
	TIME HR. Min.	0:25	0:23	0:21	0:18	0:16	0:14	0:13	0:11	0:10	0:09	0:08	0:07
15,000' -15	TAS Kts.	234	230	227	221	215	209	202	195	188	181	174	166
	FUEL #	2,560	2,360	2,190	1,890	1,660	1,470	1,310	1,160	1,030	910	810	720
	TIME HR. Min.	0:22	0:20	0:19	0:16	0:14	0:13	0:11	0:10	0:09	0:08	0:07	0:06
14,000' -13	TAS Kts.	231	228	225	219	213	207	201	194	187	180	172	164
	FUEL #	2,300	2,130	1,980	1,710	1,510	1,340	1,200	1,050	940	820	740	650
	TIME HR. Min.	0:20	0:18	0:17	0:15	0:13	0:11	0:10	0:09	0:08	0:07	0:06	0:06
13,000' -11	TAS Kts.	228	225	222	217	210	204	198	192	185	178	170	162
	FUEL #	2,080	1,950	1,810	1,580	1,390	1,220	1,090	970	860	770	690	610
	TIME HR. Min.	0:17	0:16	0:15	0:13	0:12	0:10	0:09	0:08	0:07	0:07	0:06	0:05
12,000' -9	TAS Kts.	226	223	220	214	209	202	196	190	183	176	169	161
	FUEL #	1,860	1,740	1,620	1,440	1,260	1,130	1,000	890	790	700	630	550
	TIME HR. Min.	0:16	0:15	0:14	0:12	0:11	0:09	0:08	0:08	0:07	0:06	0:05	0:05
10,000' -5	TAS Kts.	222	219	216	210	205	198	192	186	180	173	166	158
	FUEL #	1,480	1,390	1,310	1,160	1,030	930	840	750	650	590	510	460
	TIME HR. Min.	0:12	0:11	0:11	0:10	0:08	0:07	0:07	0:06	0:05	0:05	0:04	0:04

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K)

5°C
ABOVE
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT (1000#) ⇨		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE TRUE OAT °C	IAS KNOTS ⇨	205	203	200	195	190	184	179	173	167	161	156	148
24,000'	TAS Kts.					246	238	228	219	210	202	193	184
	FUEL #					4,050	3,300	2,700	2,250	1,900	1,650	1,420	1,240
-28	TIME HR. Min.					0:43	0:35	0:28	0:23	0:20	0:17	0:14	0:13
23,000'	TAS Kts.					242	233	225	216	208	200	191	182
	FUEL #					3,660	2,940	2,440	2,070	1,790	1,550	1,340	1,170
-26	TIME HR. Min.					0:36	0:30	0:25	0:21	0:18	0:16	0:14	0:12
22,000'	TAS Kts.				248	238	230	221	213	205	197	189	180
	FUEL #				3,960	3,260	2,740	2,300	1,960	1,670	1,460	1,270	1,110
-24	TIME HR. Min.				0:43	0:34	0:28	0:23	0:20	0:17	0:15	0:13	0:11
21,000'	TAS Kts.			250	242	234	226	218	211	203	195	187	178
	FUEL #			4,550	3,700	3,030	2,520	2,120	1,840	1,590	1,400	1,230	1,080
-22	TIME HR. Min.			0:55	0:36	0:29	0:25	0:21	0:18	0:16	0:14	0:12	0:10
20,000'	TAS Kts.		248	245	239	231	224	217	209	201	193	185	176
	FUEL #		4,500	4,100	3,350	2,790	2,300	1,960	1,710	1,490	1,300	1,140	990
-20	TIME HR. Min.		0:50	0:45	0:34	0:27	0:22	0:19	0:17	0:15	0:13	0:11	0:10
19,000'	TAS Kts.	251	247	243	235	228	221	213	206	199	191	183	175
	FUEL #	4,400	4,000	3,650	3,050	2,540	2,150	1,830	1,600	1,400	1,230	1,070	950
-18	TIME HR. Min.	0:43	0:39	0:35	0:29	0:24	0:20	0:18	0:15	0:13	0:12	0:10	0:09
18,000'	TAS Kts.	246	243	240	232	225	218	211	204	197	189	181	173
	FUEL #	4,040	3,680	3,350	2,760	2,340	1,990	1,700	1,500	1,300	1,150	1,000	880
-16	TIME HR. Min.	0:40	0:36	0:32	0:26	0:22	0:19	0:16	0:14	0:13	0:11	0:10	0:08
17,000'	TAS Kts.	243	240	236	229	222	215	208	201	194	187	179	171
	FUEL #	3,700	3,350	3,020	2,500	2,100	1,820	1,600	1,400	1,240	1,090	950	840
-14	TIME HR. Min.	0:33	0:30	0:27	0:23	0:20	0:17	0:15	0:13	0:11	0:10	0:09	0:08
16,000'	TAS Kts.	240	237	233	226	220	213	206	199	192	185	178	170
	FUEL #	3,200	2,960	2,700	2,300	1,950	1,690	1,450	1,290	1,140	1,010	890	790
-12	TIME HR. Min.	0:30	0:27	0:25	0:21	0:18	0:16	0:14	0:12	0:10	0:09	0:08	0:07
15,000'	TAS Kts.	236	233	230	223	217	211	204	197	190	183	176	168
	FUEL #	2,970	2,700	2,470	2,060	1,790	1,550	1,380	1,210	1,070	950	840	740
-10	TIME HR. Min.	0:26	0:24	0:22	0:19	0:16	0:14	0:12	0:11	0:10	0:09	0:08	0:07
14,000'	TAS Kts.	234	231	227	221	215	209	203	195	188	181	174	166
	FUEL #	2,650	2,420	2,200	1,900	1,640	1,430	1,250	1,100	980	860	750	670
-8	TIME HR. Min.	0:23	0:22	0:20	0:17	0:14	0:13	0:11	0:10	0:09	0:08	0:07	0:06
13,000'	TAS Kts.	231	228	225	219	213	206	200	193	187	180	172	164
	FUEL #	2,360	2,160	2,000	1,710	1,500	1,310	1,150	1,020	900	800	710	630
-6	TIME HR. Min.	0:22	0:19	0:17	0:15	0:13	0:11	0:10	0:09	0:08	0:07	0:06	0:06
12,000'	TAS Kts.	229	226	223	217	211	205	198	192	185	178	170	162
	FUEL #	2,110	1,950	1,800	1,550	1,350	1,200	1,050	940	830	730	650	570
-4	TIME HR. Min.	0:18	0:17	0:15	0:13	0:12	0:10	0:09	0:08	0:07	0:06	0:06	0:05
11,000'	TAS Kts.	226	223	220	215	209	203	197	190	184	176	169	161
	FUEL #	1,880	1,740	1,600	1,400	1,230	1,080	950	850	750	680	600	540
-2	TIME HR. Min.	0:16	0:15	0:14	0:12	0:11	0:09	0:08	0:07	0:07	0:06	0:05	0:05

10°C
ABOVE
STANDARD
TEMPERATURE

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K)

TAKEOFF GROSS WEIGHT (1000#) ⇨		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE TRUE OAT °C	IAS KNOTS ⇨	205	203	200	195	190	184	179	173	167	161	156	148
24,000' -23	TAS Kts.						240	232	222	213	204	196	186
	FUEL #						3,660	3,000	2,450	2,050	1,740	1,500	1,290
	TIME HR. Min.						0:42	0:33	0:26	0:22	0:19	0:16	0:14
23,000' -21	TAS Kts.					247	237	228	219	210	202	193	184
	FUEL #					4,420	3,350	2,690	2,250	1,920	1,650	1,400	1,220
	TIME HR. Min.					0:43	0:35	0:29	0:24	0:20	0:18	0:15	0:13
22,000' -19	TAS Kts.					242	233	224	216	207	200	191	182
	FUEL #					3,780	3,070	2,530	2,120	1,790	1,550	1,340	1,150
	TIME HR. Min.					0:41	0:33	0:27	0:22	0:19	0:16	0:14	0:12
21,000' -17	TAS Kts.				247	238	230	221	214	205	197	189	181
	FUEL #				4,400	3,480	2,830	2,320	1,970	1,690	1,470	1,280	1,110
	TIME HR. Min.				0:50	0:35	0:29	0:24	0:20	0:17	0:15	0:13	0:11
20,000' -15	TAS Kts.				243	234	227	219	211	203	195	187	178
	FUEL #				4,010	3,170	2,590	2,150	1,850	1,580	1,360	1,180	1,020
	TIME HR. Min.				0.44	0:32	0:26	0:22	0:19	0:16	0:14	0:12	0:10
19,000' -13	TAS Kts.			248	239	231	223	215	208	201	193	185	176
	FUEL #			4,420	3,560	2,880	2,350	1,980	1,700	1,490	1,300	1,130	990
	TIME HR. Min.			0:45	0:35	0:29	0:24	0:20	0:17	0:15	0:13	0:11	0:10
18,000' -11	TAS Kts.		247	243	235	228	221	214	206	199	191	183	174
	FUEL #		4,500	4,000	3,180	2,620	2,190	1,850	1,590	1,390	1,200	1,050	910
	TIME HR. Min.		0:45	0:40	0:32	0:26	0:22	0:18	0:16	0:14	0:12	0:10	0:09
17,000' -9	TAS Kts.	247	243	239	232	225	218	211	204	196	189	181	173
	FUEL #	4,610	4,010	3,540	2,850	2,340	1,990	1,730	1,480	1,300	1,120	990	860
	TIME HR. Min.	0:40	0:36	0:33	0:28	0:23	0:19	0:16	0:14	0:12	0:11	0:10	0:08
16,000' -7	TAS Kts.	244	240	236	229	222	216	209	202	194	187	180	172
	FUEL #	3,740	3,440	3,130	2,640	2,150	1,850	1,590	1,390	1,200	1,060	920	810
	TIME HR. Min.	0:37	0:33	0:30	0:25	0:21	0:18	0:15	0:13	0:11	0:10	0:09	0:08
15,000' -5	TAS Kts.	240	236	232	226	219	213	206	199	192	185	177	169
	FUEL #	3,550	3,180	2,850	2,340	1,980	1,700	1,480	1,280	1,120	990	860	760
	TIME HR. Min.	0:32	0:29	0:26	0:22	0:19	0:16	0:14	0:12	0:11	0:09	0:08	0:07
14,000' -3	TAS Kts.	237	233	230	224	217	211	204	197	190	183	176	168
	FUEL #	3,100	2,800	2,540	2,140	1,800	1,550	1,350	1,190	1,030	910	800	700
	TIME HR. Min.	0:28	0:26	0:24	0:20	0:17	0:14	0:12	0:11	0:09	0:08	0:07	0:06
13,000' -1	TAS Kts.	233	230	227	221	215	209	202	196	189	182	174	166
	FUEL #	2,750	2,450	2,250	1,900	1,650	1,410	1,240	1,080	950	840	740	650
	TIME HR. Min.	0:25	0:23	0:21	0:17	0:15	0:13	0:11	0:10	0:09	0:08	0:07	0:06
12,000' +1	TAS Kts.	231	228	225	219	213	207	200	194	187	179	172	164
	FUEL #	2,440	2,220	2,020	1,720	1,480	1,300	1,140	1,000	880	780	680	600
	TIME HR. Min.	0:22	0:20	0:18	0:16	0:13	0:12	0:10	0:09	0:08	0:07	0:06	0:05
11,000' +3	TAS Kts.	229	226	223	217	211	205	198	192	185	178	171	163
	FUEL #	2,140	1,950	1,790	1,540	1,350	1,150	1,000	890	800	700	620	550
	TIME HR. Min.	0:19	0:17	0:16	0:14	0:12	0:10	0:09	0:08	0:07	0:06	0:06	0:05

15°C
ABOVE
STANDARD
TEMPERATURE

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K)

AKEOFF ROSS WEIGHT 1000#)		210	205	200	190	180	170	160	150	140	130	120	110
RESSURE LTITUDE RUE OAT °C	IAS KNOTS	205	203	200	195	190	184	179	173	167	161	156	148
24,000'	TAS Kts.							235	225	216	207	198	188
	FUEL #							3,420	2,700	2,210	1,850	1,560	1,340
-18	TIME HR. Min.							0:39	0:30	0:25	0:21	0:17	0:15
23,000'	TAS Kts.						241	232	222	213	204	196	186
	FUEL #						4,050	3,100	2,500	2,080	1,750	1,490	1,280
-16	TIME HR. Min.						0:47	0:35	0:28	0:23	0:19	0:16	0:1[illegible]
22,000'	TAS Kts.						237	228	219	210	201	193	184
	FUEL #						3,500	2,810	2,300	1,930	1,650	1,410	1,200
-14	TIME HR. Min.						0:39	0:31	0:25	0:21	0:18	0:15	0:13
21,000'	TAS Kts.					243	233	224	216	208	199	191	182
	FUEL #					4,240	3,250	2,590	2,150	1,810	1,550	1,340	1,150
-12	TIME HR. Min.					0:46	0:35	0:28	0:23	0:19	0:16	0:14	0:12
20,000'	TAS Kts.					238	230	221	213	205	197	189	180
	FUEL #					3,720	2,900	2,390	2,000	1,700	1,450	1,250	1,060
-10	TIME HR. Min.					0:40	0:31	0:25	0:21	0:18	0:15	0:13	0:11
19,000'	TAS Kts.				243	234	225	218	210	202	195	187	178
	FUEL #				4,390	3,350	2,660	2,190	1,840	1,590	1,360	1,180	1,020
-8	TIME HR. Min.				0:46	0:35	0:28	0:23	0:19	0:16	0:14	0:12	0:10
18,000'	TAS Kts.				239	231	223	216	208	201	193	185	176
	FUEL #				3,710	2,980	2,440	2,020	1,730	1,480	1,280	1,100	950
-6	TIME HR. Min.				0:38	0:31	0:25	0:21	0:18	0:15	0:13	0:11	0:10
17,000'	TAS Kts.			243	235	228	220	213	205	198	190	182	174
	FUEL #			4,470	3,350	2,680	2,230	1,880	1,600	1,380	1,200	1,030	900
-4	TIME HR. Min.			0:46	0:34	0:27	0:22	0:19	0:16	0:14	0:12	0:10	0:09
16,000'	TAS Kts.		243	239	232	225	218	211	203	196	189	182	174
	FUEL #		4,440	3,830	3,010	2,440	2,040	1,730	1,460	1,260	1,110	960	840
-2	TIME HR. Min.		0:44	0:38	0:30	0:24	0:20	0:17	0:14	0:12	0:11	0:10	0:08
15,000'	TAS Kts.	243	239	235	228	222	215	208	201	194	186	179	171
	FUEL #	4,480	3,820	3,360	2,690	2,220	1,850	1,590	1,360	1,180	1,[illegible]30	900	790
0	TIME HR. Min.	0:44	0:38	0:33	0:26	0:22	0:18	0:15	0:13	0:12	0:10	0:09	0:08
14,000'	TAS Kts.	240	237	233	226	220	213	206	199	192	185	178	170
	FUEL #	3,800	3,370	2,960	2,420	2,000	1,700	1,460	1,250	1,090	950	830	720
+2	TIME HR. Min.	0:37	0:32	0:28	0:23	0:19	0:16	0:14	0:12	0:10	0:09	0:08	0:07
13,000'	TAS Kts.	236	233	230	224	217	211	204	198	191	183	176	168
	FUEL #	3,300	2,950	2,630	2,150	1,810	1,550	1,340	1,150	1,000	880	770	680
+4	TIME HR. Min.	0:31	0:28	0:25	0:20	0:17	0:14	0:12	0:11	0:10	0:08	0:07	0:06
12,000'	TAS Kts.	233	230	228	221	215	209	202	195	189	181	173	165
	FUEL #	2,860	2,580	2,310	1,940	1,630	1,400	1,210	1,050	920	810	700	620
+6	TIME HR. Min.	0:27	0:24	0:22	0:18	0:15	0:13	0:11	0:10	0:09	0:08	0:07	0:06
11,000'	TAS Kts.	231	228	225	219	213	207	200	194	187	180	172	165
	FUEL #	2,500	2,270	2,050	1,740	1,480	1,250	1,090	940	830	730	650	570
+8	TIME HR. Min.	0:23	0:21	0:19	0:16	0:14	0:12	0:10	0:09	0:08	0:07	0:06	0:05

CLIMB FOUR ENGINES 88.5% LP RPM (1164°K)

20°C
ABOVE
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT (1000#)		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE TRUE OAT °C	IAS KNOTS	205	203	200	195	190	184	179	173	167	161	156	148
24,000' -13	TAS Kts. FUEL # TIME HR. Min.							239 3,820 0:47	229 3,050 0:36	219 2,450 0:29	210 2,040 0:23	200 1,690 0:19	191 1,430 0:16
23,000' -11	TAS Kts. FUEL # TIME HR. Min.							235 3,700 0:43	225 2,850 0:32	216 2,270 0:26	207 1,880 0:21	198 1,570 0:18	188 1,320 0:15
22,000' -9	TAS Kts. FUEL # TIME HR. Min.						241 4,100 0:51	231 3,200 0:37	222 2,580 0:29	212 2,120 0:24	204 1,790 0:20	195 1,500 0:17	186 1,290 0:14
21,000' -7	TAS Kts. FUEL # TIME HR. Min.						237 3,900 0:46	227 2,990 0:33	219 2,400 0:27	210 1,980 0:22	201 1,670 0:18	193 1,420 0:15	184 1,220 0:13
20,000' -5	TAS Kts. FUEL # TIME HR. Min.						233 3,360 0:38	224 2,710 0:30	216 2,240 0:24	207 1,850 0:20	199 1,550 0:17	191 1,310 0:14	182 1,120 0:12
19,000' -3	TAS Kts. FUEL # TIME HR. Min.					238 4,010 0:43	229 3,100 0:33	220 2,490 0:27	213 2,050 0:22	205 1,710 0:18	197 1,460 0:15	189 1,250 0:13	180 1,070 0:11
18,000' -1	TAS Kts. FUEL # TIME HR. Min.					235 3,440 0:37	227 2,760 0:29	219 2,260 0:24	211 1,900 0:20	203 1,600 0:17	195 1,360 0:14	187 1,160 0:12	178 1,000 0:11
17,000' +1	TAS Kts. FUEL # TIME HR. Min.				238 3,990 0:42	231 3,140 0:33	223 2,510 0:27	215 2,080 0:22	207 1,740 0:18	200 1,480 0:16	192 1,270 0:13	184 1,090 0:11	176 940 0:10
16,000' +3	TAS Kts. FUEL # TIME HR. Min.				235 3,460 0:35	228 2,800 0:29	221 2,320 0:23	213 1,940 0:19	206 1,630 0:16	198 1,360 0:14	191 1,200 0:12	184 1,010 0:10	175 890 0:09
15,000' +5	TAS Kts. FUEL # TIME HR. Min.			238 4,060 0:42	231 3,210 0:32	224 2,560 0:26	217 2,110 0:21	210 1,740 0:18	203 1,470 0:15	196 1,260 0:13	188 1,090 0:11	181 950 0:10	172 810 0:08
14,000' +7	TAS Kts. FUEL # TIME HR. Min.		239 3,990 0:37	236 3,480 0:34	229 2,800 0:28	222 2,300 0:23	215 1,920 0:19	208 1,600 0:16	201 1,380 0:14	194 1,170 0:12	187 1,010 0:10	180 880 0:09	171 760 0:07
13,000' +9	TAS Kts. FUEL # TIME HR. Min.	239 4,080 0:39	236 3,550 0:34	233 3,150 0:31	226 2,520 0:25	220 2,040 0:20	213 1,720 0:17	206 1,460 0:14	200 1,250 0:12	192 1,080 0:11	185 940 0:09	178 810 0:08	170 710 0:07
12,000' +11	TAS Kts. FUEL # TIME HR. Min.	236 3,420 0:36	233 3,040 0:31	230 2,720 0:27	224 2,210 0:22	217 1,840 0:18	211 1,550 0:15	204 1,340 0:13	197 1,150 0:11	190 1,000 0:10	183 850 0:08	175 750 0:07	167 640 0:06
11,000' +13	TAS Kts. FUEL # TIME HR. Min.	234 3,050 0:29	231 2,730 0:26	227 2,440 0:23	221 1,990 0:19	215 1,650 0:16	209 1,390 0:13	202 1,190 0:11	195 1,030 0:10	189 890 0:09	181 780 0:08	174 680 0:07	166 600 0:06

2. Normal Four Engine Cruise

Normal four engine cruise is conducted at 88.5% LP rpm (13,500) and 1164° K Turbine Inlet Temperature. The cruise tables contained in pages 2.12 to 2.57 are differentiated by Zero Fuel Weight and altitude, a table being presented for every 1,000 foot altitude between 10,000 and 24,000 feet and for every 2,000 feet thereafter to 30,000 feet. These tables should normally be used for all four engine operations, except when restricted to lower altitudes, at which time the Intermediate Cruise data should be considered (Sect. 3).

At each altitude where performance is not limited by the V_{no} speed one table suffices for all Zero Fuel Weights and is therefore headed 155,000 lb and less When the V_{no} limit does occur, additional tables for Zero Fuel Weights of 145,000 lb and 135,000 lb are provided as required.

The time elapsed in consuming the 10,000 lb of fuel in each weight bracket is essentially constant with rpm. When variation in rpm and therefore fuel flow does occur, the related weight at which the change occurs is indicated in brackets in the third column from the left (thousands of lbs).

Where applicable, a solid black line distinguishes between maximum rpm operation to the left and V_{no} limited operation to the right.

The data in these tables are equally applicable to long range cruise procedure since this also requires maximum recommended cruise power. The L.R.C. procedure will be concerned with only the heaviest weight bracket(s) appropriate to the temperature since a step will be made to the next higher altitude as the weight is suitably reduced.

The extreme L.R.C. would consist of a cruise climb technique matching maximum altitude with the decreasing weight according to Figure 1-2. Modified L.R.C. procedures would normally involve one weight bracket (10,000 lb and approximately 2 hours) or two (20,000 lb and approximately 4 hours) at each altitude.

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 10,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts .											
+20	+15	(197) 1:42 (145) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 295 88.5 247	1,470 301 88.0 252	1,440 301 86.0 252	1,410 301 85.0 253	1,380 301 84.1 253	1,350 301 83.4 253	1,330 301 82.5 253				
-15	+10	(205) 1:41 (145) 1:54	FF/Eng. #/Hr. TAS Kts . % RPM IAS Kts.	1,490 299 85.8 252	1,450 299 84.8 252	1,420 299 83.9 252	1,390 299 83.0 253	1,370 299 82.1 253	1,340 299 81.4 253	1,310 299 80.7 253				
+10	+5	(205) 1:42 (145) 1:55	FF/Eng. #/Hr . TAS Kts. % RPM IAS Kts.	1,470 296 83.8 252	1,440 296 82.8 252	1,410 296 81.9 252	1,380 296 81.0 253	1,350 296 80.2 253	1,330 296 79.4 253	1,300 296 78.8 253				
+5	0	(205) 1:43 (145) 1:56	FF/Eng. #/Hr . TAS Kts . % RPM IAS Kts.	1,460 293 81.6 252	1,430 293 80.8 252	1,390 293 79.9 252	1,370 293 79.1 253	1,340 293 78.3 253	1,310 293 77.6 253	1,290 293 76.8 253				
Std.	-5	(205) 1:44 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 290 79.7 252	1,410 290 78.8 252	1,380 290 78.0 252	1,350 290 77.2 253	1,330 290 76.4 253	1,300 290 75.8 253	1,280 290 75.2 253				
-5	-10	(205) 1:45 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,430 288 78.5 252	1,400 288 77.7 252	1,370 288 76.8 252	1,340 288 76.1 253	1,310 288 75.3 253	1,290 288 74.7 253	1,260 288 74.2 253				
-10	-15	(205) 1:46 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IA SKts.	1,410 285 78.9 252	1,380 285 78.1 252	1,350 285 77.3 252	1,320 285 76.5 253	1,300 285 75.8 253	1,270 285 75.1 253	1,250 285 74.4 253				
-15	-20	(205) 1:47 (145) 2:01	FF/Eng. #/Hr. TAS Kts. %oRPM IAS Kts.	1,400 282 78.4 252	1,370 282 77.6 252	1,340 282 76.8 252	1,310 282 76.0 253	1,280 282 75.3 253	1,260 282 74.6 253	1,240 282 73.9 253				
-20	-25	(205) 1:49 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 280 77.9 252	1,350 280 77.1 252	1,320 280 76.3 252	1,300 280 75.5 253	1,270 280 74.8 253	1,250 280 74.1 253	1,230 280 73.5 253				
-25	-30	(205) 1:49 (145) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,370 277 77.6 252	1,340 277 76.7 252	1,310 277 75.9 252	1,280 277 75.2 253	1,260 277 74.5 253	1,240 277 73.8 253	1,210 277 73.1 253				
-30	-35	(205) 1:50 (145) 2:05	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 274 77.2 252	1,330 274 76.4 252	1,300 274 75.6 252	1,270 274 74.9 253	1,250 274 74.1 253	1,220 274 73.4 253	1,200 274 72.8 253				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 10,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+15	(166) 1:41 (135) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 295 88.5 247	1,480 302 88.5 253	1,480 308 88.5 258	1,480 312 88.5 263	1,470 316 88.2 266	1,450 316 86.6 266	1,430 316 85.6 266	1,400 316 85.0 266			
+15	+10	(193) 1:37 (135) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 307 88.5 260	1,540 312 88.5 264	1,510 313 87.1 265	1,490 313 85.7 266	1,460 313 84.9 266	1,440 313 84.2 266	1,410 313 83.5 266	1,390 313 82.9 266			
+10	+5	(205) 1:36 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,560 310 86.4 265	1,530 310 85.2 265	1,500 310 84.4 265	1,470 310 83.6 266	1,450 310 82.9 266	1,420 310 82.2 266	1,400 310 81.6 266	1,380 310 81.0 266			
+5	0	(205) 1:37 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,540 307 83.9 265	1,510 307 83.1 265	1,480 307 82.3 265	1,460 307 81.6 266	1,430 307 80.8 266	1,410 307 80.2 266	1,380 307 79.6 266	1,360 307 79.0 266			
Std.	-5	(205) 1:38 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 305 81.9 265	1,500 305 81.0 265	1,470 305 80.3 265	1,440 305 79.6 266	1,420 305 78.9 266	1,390 305 78.2 266	1,370 305 77.7 266	1,350 305 77.0 266			
-5	-10	(205) 1:39 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,510 302 80.6 265	1,480 302 79.8 265	1,450 302 79.1 265	1,430 302 78.3 266	1,400 302 77.7 266	1,380 302 77.0 266	1,360 302 76.4 266	1,340 302 75.8 266			
-10	-15	(205) 1:40 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 299 80.7 265	1,470 299 80.0 265	1,440 299 79.3 265	1,410 299 78.7 266	1,390 299 78.1 266	1,360 299 77.5 266	1,340 299 76.9 266	1,320 299 76.3 266			
-15	-20	(205) 1:41 (135) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,480 296 80.2 265	1,450 296 79.4 265	1,420 296 78.8 265	1,400 296 78.1 266	1,370 296 77.5 266	1,350 296 76.9 266	1,330 296 76.3 266	1,310 296 75.7 266			
-20	-25	(205) 1:43 (135) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,460 293 79.8 265	1,430 293 79.0 265	1,410 293 78.3 265	1,380 293 77.6 266	1,360 293 77.0 266	1,340 293 76.4 266	1,310 293 75.8 266	1,290 293 75.2 266			
-25	-30	(205) 1:44 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 290 79.4 265	1,420 290 78.6 265	1,390 290 78.0 265	1,370 290 77.3 266	1,340 290 76.6 266	1,320 290 76.0 266	1,300 290 75.4 266	1,280 290 74.9 266			
-30	-35	(205) 1:44 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 287 79.2 265	1,410 287 78.4 265	1,380 287 77.6 265	1,360 287 77.0 266	1,330 287 76.3 266	1,310 287 75.7 266	1,290 287 75.1 266	1,270 287 74.6 266			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Vno 275 KTS EAS
ALT 10,000 FT

EV. ROM D. EMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 10
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+15	(205) 1:42 (110) 1:41	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 295 88.5 247	1,480 302 88.5 253	1,480 308 88.5 258	1,480 312 88.5 263	1,480 316 88.5 266	1,480 320 88.5 270	1,480 323 88.5 272	1,480 326 88.5 275	1,480 329 88.5 279	1,480 331 88.5 280	1,470 331 87.1 280
+15	+10	(150) 1:37 (105) 1:43	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 307 88.5 260	1,540 312 88.5 264	1,540 317 88.5 268	1,540 321 88.5 273	1,540 324 88.5 276	1,540 327 88.5 278	1,530 329 87.8 280	1,510 329 86.6 280	1,490 329 85.7 281	1,470 329 85.2 281	1,460 329 84.6 281
+10	+5	(182) 1:34 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,590 317 88.5 271	1,600 321 88.5 275	1,600 325 88.5 278	1,580 326 86.4 280	1,560 326 85.4 280	1,540 326 84.8 280	1,510 326 84.1 280	1,490 326 83.6 280	1,480 326 83.1 281	1,460 326 82.6 281	1,440 326 82.2 281
+5	0	(205) 1:31 (105) 1:45	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,650 323 87.3 279	1,620 323 85.7 279	1,590 323 84.8 279	1,570 323 84.1 280	1,540 323 83.3 280	1,520 323 82.7 280	1,500 323 82.1 280	1,480 323 81.6 280	1,460 323 81.1 281	1,440 323 80.6 281	1,430 323 80.2 281
Std.	-5	(205) 1:32 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,630 320 84.4 279	1,600 320 83.6 279	1,580 320 83.0 279	1,550 320 82.3 280	1,530 320 81.6 280	1,510 320 81.1 280	1,490 320 80.5 280	1,470 320 80.0 280	1,450 320 79.4 281	1,430 320 79.1 281	1,410 320 78.8 281
-5	-10	(205) 1:33 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,620 317 83.1 279	1,590 317 82.3 279	1,560 317 81.6 279	1,530 317 81.1 280	1,510 317 80.4 280	1,490 317 79.9 280	1,470 317 79.4 280	1,450 317 78.9 280	1,430 317 78.5 281	1,420 317 78.0 281	1,400 317 77.6 281
-10	-15	(205) 1:34 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,600 314 82.8 279	1,570 314 82.2 279	1,550 314 81.6 279	1,520 314 81.0 280	1,500 314 80.5 280	1,470 314 80.0 280	1,450 314 79.5 280	1,430 314 79.0 280	1,420 314 78.6 281	1,400 314 78.2 281	1,380 314 77.8 281
-15	-20	(205) 1:34 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,590 311 82.2 279	1,560 311 81.6 279	1,530 311 81.0 279	1,510 311 80.5 280	1,480 311 80.0 280	1,460 311 79.4 280	1,440 311 78.9 280	1,420 311 78.4 280	1,400 311 78.0 281	1,390 311 77.5 281	1,370 311 77.2 281
-20	-25	(205) 1:36 (105) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 308 81.8 279	1,540 308 81.1 279	1,510 308 80.5 279	1,490 308 79.9 280	1,460 308 79.3 280	1,440 308 78.8 280	1,420 308 78.3 280	1,400 308 77.8 280	1,390 308 77.4 281	1,370 308 77.0 281	1,350 308 76.6 281
-25	-30	(205) 1:37 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,550 304 81.4 279	1,520 304 80.7 279	1,500 304 80.0 279	1,470 304 79.4 280	1,450 304 78.8 280	1,430 304 78.3 280	1,410 304 77.8 280	1,390 304 77.4 280	1,370 304 76.9 281	1,360 304 76.5 281	1,340 304 76.2 281
-30	-35	(205) 1:38 (105) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 301 81.1 279	1,510 301 80.4 279	1,480 301 79.8 279	1,460 301 79.2 280	1,430 301 78.5 280	1,410 301 78.0 280	1,390 301 77.4 280	1,370 301 77.0 280	1,360 301 76.6 281	1,340 301 76.2 281	1,330 301 75.9 281

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 11,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+13	(187) 1:44 (145) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 294 88.5 242	1,440 301 88.5 248	1,440 306 87.3 253	1,410 306 85.7 254	1,380 306 84.8 254	1,350 306 84.0 254	1,330 306 83.3 254				
+15	+8	(205) 1:41 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 303 87.8 253	1,450 303 85.7 253	1,420 303 84.7 253	1,390 303 83.8 254	1,370 303 82.9 254	1,340 303 82.1 254	1,310 303 81.3 254				
+10	+3	(205) 1:42 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 301 84.2 253	1,440 301 83.4 253	1,410 301 82.3 253	1,380 301 81.6 254	1,350 301 80.8 254	1,320 301 80.1 254	1,300 301 79.5 254				
+5	-2	(205) 1:43 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,460 298 82.3 253	1,420 298 81.3 253	1,390 298 80.4 253	1,360 298 79.6 254	1,340 298 78.9 254	1,310 298 78.1 254	1,290 298 77.5 254				
Std.	-7	(205) 1:44 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 295 80.5 253	1,410 295 79.7 253	1,380 295 78.8 253	1,350 295 78.0 254	1,320 295 77.2 254	1,300 295 76.4 254	1,270 295 75.8 254				
-5			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 11,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+13	(153) 1:43 (135) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 294 88.5 242	1,440 301 88.5 248	1,440 307 88.5 254	1,440 312 88.5 259	1,440 317 88.5 263	1,440 320 88.5 265	1,430 321 88.2 266	1,410 321 87.0 266			
+15	+8	(181) 1:40 (135) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 306 88.5 255	1,500 311 88.5 259	1,500 316 88.5 264	1,490 318 87.6 266	1,460 318 85.8 266	1,440 318 85.0 266	1,410 318 84.3 266	1,390 318 83.7 266			
+10	+3	(205) 1:36 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,560 315 87.5 265	1,530 315 85.7 265	1,500 315 85.0 265	1,470 315 84.2 266	1,450 315 83.5 266	1,420 315 82.8 266	1,400 315 82.1 266	1,380 315 81.4 266			
+5	-2	(205) 1:37 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,540 312 84.5 265	1,510 312 83.7 265	1,480 312 82.9 265	1,460 312 82.1 266	1,430 312 81.4 266	1,410 312 80.8 266	1,380 312 80.1 266	1,360 312 79.5 266			
Std.	-7	(205) 1:38 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 309 82.8 265	1,500 309 81.9 265	1,470 309 81.1 265	1,440 309 80.3 266	1,420 309 79.6 266	1,390 309 78.9 266	1,370 309 78.4 266	1,350 309 77.8 266			
-5			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LES
Vno 275 KTS EA
ALT 11,000 F

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+13	(205) 1:44 (105) 1:43	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 294 88.5 242	1,440 301 88.5 248	1,440 307 88.5 254	1,440 312 88.5 259	1,440 317 88.5 263	1,440 320 88.5 265	1,440 324 88.5 269	1,450 327 88.5 272	1,450 329 88.5 274	1,450 332 88.5 277	1,450 334 88.5 279
+15	+8	(132) 1:39 (105) 1:43	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 306 88.5 255	1,500 311 88.5 259	1,500 316 88.5 264	1,500 321 88.5 269	1,500 325 88.5 273	1,510 328 88.5 275	1,510 331 88.5 278	1,510 333 88.5 280	1,490 334 87.8 282	1,470 334 86.7 282	1,460 334 85.7 282
+10	+3	(167) 1:36 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,560 316 88.5 266	1,560 321 88.5 271	1,560 325 88.5 274	1,560 328 88.5 278	1,560 331 87.3 281	1,540 331 86.0 281	1,520 331 85.3 281	1,500 331 84.6 281	1,480 331 84.1 282	1,460 331 83.7 282	1,440 331 83.2 282
+5	-2	(198) 1:32 (105) 1:45	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,630 325 88.5 277	1,620 328 87.6 280	1,600 328 85.9 280	1,570 328 85.1 281	1,550 328 84.5 281	1,520 328 83.8 281	1,500 328 83.1 281	1,480 328 82.6 281	1,460 328 82.1 282	1,450 328 81.6 282	1,430 328 81.2 282
Std.	-7	(205) 1:31 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,640 325 85.5 280	1,610 325 84.7 280	1,580 325 83.9 280	1,550 325 83.2 281	1,530 325 82.7 281	1,510 325 82.1 281	1,490 325 81.4 281	1,470 325 80.9 281	1,450 325 80.4 282	1,430 325 79.9 282	1,410 325 79.5 282
-5			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 12,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+11	(176) 1:46 (145) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 290 88.5 235	1,400 299 88.5 243	1,410 306 88.5 249	1,410 311 88.2 254	1,380 311 86.2 254	1,350 311 85.1 254	1,330 311 84.3 254				
+15	+6	(198) 1:41 (145) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 304 88.5 250	1,460 308 87.8 253	1,420 308 85.8 253	1,390 308 84.8 254	1,370 308 83.9 254	1,340 308 83.0 254	1,310 308 82.2 254				
+10	+1	(205) 1:42 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 305 85.0 253	1,440 305 84.0 253	1,410 305 83.1 253	1,380 305 82.2 254	1,350 305 81.4 254	1,320 305 80.8 254	1,300 305 80.0 254				
+5	-4	(205) 1:43 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,460 303 83.0 253	1,430 303 82.0 253	1,390 303 81.2 253	1,360 303 80.4 254	1,340 303 79.6 254	1,310 303 78.8 254	1,290 303 78.2 254				
Std.	-9	(205) 1:44 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 300 81.6 253	1,410 300 80.5 253	1,380 300 79.6 253	1,350 300 78.8 254	1,320 300 77.9 254	1,300 300 77.2 254	1,270 300 76.5 254				
-5	-14	(205) 1:45 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,430 297 80.4 253	1,390 297 79.4 253	1,370 297 78.6 253	1,340 297 77.7 254	1,310 297 76.8 254	1,280 297 76.2 254	1,260 297 75.5 254				
-10	-19	(205) 1:46 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 294 80.4 253	1,380 294 79.5 253	1,350 294 78.7 253	1,320 294 77.9 254	1,290 294 77.2 254	1,270 294 76.5 254	1,250 294 75.9 254				
-15	-24	(205) 1:47 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 291 79.8 253	1,370 291 78.9 253	1,340 291 78.1 253	1,310 291 77.3 254	1,280 291 76.6 254	1,260 291 75.9 254	1,240 291 75.2 254				
-20	-29	(205) 1:48 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,390 288 79.2 253	1,360 288 78.3 253	1,330 288 77.5 253	1,300 288 76.7 254	1,270 288 75.9 254	1,250 288 75.2 254	1,220 288 74.6 254				
-25	-34	(205) 1:50 (145) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,370 285 78.9 253	1,340 285 78.0 253	1,310 285 77.2 253	1,280 285 76.4 254	1,260 285 75.6 254	1,230 285 75.0 254	1,210 285 74.3 254				
-30	-39	(205) 1:50 (145) 2:05	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 282 78.7 253	1,330 282 77.8 253	1,300 282 77.0 253	1,270 282 76.2 254	1,250 282 75.5 254	1,220 282 74.9 254	1,200 282 74.2 254				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 12,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+11	(139) 1:46 (135) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 290 88.5 235	1,400 299 88.5 242	1,410 306 88.5 249	1,410 312 88.5 255	1,410 316 88.5 258	1,410 320 88.5 261	1,410 324 88.5 265	1,410 326 87.6 266			
+15	+6	(169) 1:41 (135) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 304 88.5 250	1,470 310 88.5 254	1,470 316 88.5 260	1,470 320 88.5 264	1,470 323 88.0 266	1,440 323 86.4 266	1,420 323 85.3 266	1,390 323 84.6 266			
+10	+1	(194) 1:37 (135) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 315 88.5 261	1,530 320 88.5 265	1,500 320 85.8 265	1,470 320 85.0 266	1,450 320 84.3 266	1,420 320 83.6 266	1,400 320 82.8 266	1,380 320 82.3 266			
+5	-4	(205) 1:37 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,550 317 85.5 265	1,520 317 84.6 265	1,490 317 83.8 265	1,460 317 83.0 266	1,430 317 82.2 266	1,410 317 81.4 266	1,390 317 80.8 266	1,370 317 80.1 266			
Std.	-9	(205) 1:38 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 314 83.8 265	1,500 314 82.8 265	1,470 314 82.1 265	1,440 314 81.2 266	1,420 314 80.5 266	1,390 314 79.8 266	1,370 314 79.2 266	1,350 314 78.6 266			
-5	-14	(205) 1:39 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,520 311 82.7 265	1,490 311 81.8 265	1,460 311 80.9 265	1,430 311 80.1 266	1,400 311 79.4 266	1,380 311 78.6 266	1,360 311 78.0 266	1,340 311 77.5 266			
-10	-19	(205) 1:40 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 308 82.5 265	1,470 308 81.6 265	1,440 308 80.8 265	1,410 308 80.1 266	1,390 308 79.4 266	1,370 308 78.8 266	1,340 308 78.2 266	1,320 308 77.7 266			
-15	-24	(205) 1:41 (135) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 305 81.8 265	1,460 305 81.0 265	1,430 305 80.3 265	1,400 305 79.6 266	1,370 305 78.9 266	1,350 305 78.2 266	1,330 305 77.6 266	1,310 305 77.1 266			
-20	-29	(205) 1:42 (135) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 302 81.1 265	1,440 302 80.4 265	1,410 302 79.7 265	1,380 302 79.0 266	1,360 302 78.4 266	1,340 302 77.7 266	1,320 302 77.1 266	1,300 302 76.6 266			
-25	-34	(205) 1:43 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 299 80.7 265	1,420 299 80.0 265	1,400 299 79.3 265	1,370 299 78.6 266	1,340 299 78.0 266	1,320 299 77.3 266	1,300 299 76.7 266	1,280 299 76.1 266			
-30	-39	(205) 1:44 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 296 80.4 265	1,410 296 79.6 265	1,380 296 79.0 265	1,360 296 78.3 266	1,330 296 77.7 266	1,310 296 77.0 266	1,290 296 76.5 266	1,270 296 75.9 266			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Vno 275 KTS EAS
ALT 12,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+11	(205) 1:47 (105) 1:45	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 290 88.5 235	1,400 299 88.5 242	1,410 306 88.5 249	1,410 312 88.5 255	1,410 316 88.5 258	1,410 320 88.5 261	1,410 324 88.5 265	1,410 328 88.5 268	1,410 331 88.5 272	1,410 333 88.5 274	1,420 335 88.5 277
+15	+6	(112) 1:42 (105) 1:42	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 304 88.5 250	1,470 310 88.5 254	1,470 316 88.5 260	1,470 320 88.5 264	1,470 325 88.5 268	1,470 328 88.5 271	1,470 331 88.5 274	1,470 334 88.5 276	1,470 337 88.5 280	1,470 339 88.5 282	1,460 339 87.8 282
+10	+1	(150) 1:38 (105) 1:43	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 315 88.5 261	1,530 320 88.5 265	1,530 325 88.5 270	1,530 328 88.5 274	1,530 332 88.5 277	1,530 335 88.5 280	1,520 336 86.8 281	1,500 336 85.8 281	1,480 336 85.2 282	1,460 336 84.7 282	1,450 336 84.2 282
+5	-4	(184) 1:34 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,590 324 88.5 272	1,590 329 88.5 276	1,590 333 88.5 280	1,580 333 86.4 281	1,550 333 85.5 281	1,530 333 84.8 281	1,510 333 84.2 281	1,490 333 83.6 281	1,470 333 83.1 282	1,450 333 82.5 282	1,430 333 82.1 282
Std.	-9	(205) 1:31 (105) 1:45	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,640 330 87.4 280	1,610 330 85.8 280	1,590 330 85.1 280	1,560 330 84.4 281	1,530 330 83.8 281	1,510 330 83.1 281	1,490 330 82.5 281	1,470 330 81.9 281	1,950 330 81.4 282	1,430 330 80.9 282	1,420 330 80.4 282
-5	-14	(205) 1:32 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,630 327 85.1 280	1,600 327 84.4 280	1,570 327 83.5 280	1,540 327 82.9 281	1,520 327 82.2 281	1,500 327 81.6 281	1,470 327 81.2 281	1,450 327 80.6 281	1,430 327 80.1 282	1,420 327 79.7 282	1,400 327 79.2 282
-10	-19	(205) 1:33 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,610 324 84.6 280	1,580 324 83.8 280	1,550 324 83.2 280	1,530 324 82.6 281	1,500 324 82.0 281	1,480 324 81.5 281	1,460 324 81.0 281	1,440 324 80.5 281	1,420 324 80.1 282	1,400 324 79.7 282	1,390 324 79.4 282
-15	-24	(205) 1:34 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,590 321 83.8 280	1,560 321 83.1 280	1,540 321 82.4 280	1,510 321 81.8 281	1,490 321 81.3 281	1,460 321 80.8 281	1,450 321 80.3 281	1,430 321 79.8 281	1,410 321 79.4 282	1,390 321 79.0 282	1,370 321 78.6 282
-20	-29	(205) 1:35 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,580 318 83.3 280	1,550 318 82.6 280	1,520 318 82.0 280	1,500 318 81.4 281	1,470 318 80.8 281	1,450 318 80.3 281	1,430 318 79.8 281	1,410 318 79.4 281	1,390 318 78.9 282	1,370 318 78.5 282	1,360 318 78.1 282
-25	-34	(205) 1:36 (105) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,560 314 83.0 280	1,530 314 82.4 280	1,510 314 81.8 280	1,480 314 81.2 2281	1,460 314 80.6 281	1,440 314 80.0 281	1,420 314 79.4 281	1,400 314 79.0 281	1,380 314 78.5 282	1,360 314 78.1 282	1,350 314 77.8 282
-30	-39	(205) 1:37 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,550 311 82.9 280	1,520 311 82.2 280	1,490 311 81.6 280	1,470 311 81.0 281	1,450 311 80.4 281	1,420 311 79.9 281	1,400 311 79.4 281	1,390 311 78.9 281	1,370 311 78.4 282	1,350 311 78.0 282	1,340 311 77.6 282

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 13,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+9	(164) 1:50 (145) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,360 297 88.5 237	1,370 304 88.5 243	1,370 311 88.5 250	1,370 316 88.5 254	1,350 316 88.3 254	1,330 316 85.9 254				
+15	+4	(188) 1:45 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 301 88.5 243	1,430 309 88.5 250	1,420 313 88.3 253	1,390 313 86.3 254	1,370 313 85.1 254	1,340 313 84.1 254	1,310 313 83.4 254				
+10	-1	(205) 1:42 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 310 85.9 253	1,440 310 84.9 253	1,410 310 84.0 253	1,380 310 83.1 254	1,350 310 82.3 254	1,320 310 81.6 254	1,300 310 81.0 254				
+5	-6	(205) 1:43 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,460 308 84.1 253	1,430 308 83.1 253	1,400 308 82.1 253	1,370 308 81.2 254	1,340 308 80.4 254	1,310 308 79.7 254	1,290 308 78.9 254				
Std.	-11	(205) 1:44 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 305 82.5 253	1,410 305 81.6 253	1,380 305 80.5 253	1,350 305 79.7 254	1,320 305 78.8 254	1,300 305 78.0 254	1,270 305 77.3 254				
-5			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS FAS
ALT 13,000 FT

EV. ROM D. EMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+9	(195) 1:50 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,360 297 88.5 237	1,370 304 88.5 243	1,370 311 88.5 250	1,370 316 88.5 254	1,380 321 88.5 259	1,380 325 88.5 262	1,380 328 88.5 265			
+15	+4	(155) 1:45 (135) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 301 88.5 243	1,430 309 88.5 250	1,430 315 88.5 255	1,430 320 88.5 260	1,430 325 88.5 264	1,430 328 88.5 267	1,420 328 87.1 267	1,390 328 85.7 267			
+10	-1	(182) 1:41 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 313 88.5 256	1,490 319 88.5 260	1,490 324 88.5 265	1,480 325 86.4 267	1,450 325 85.4 267	1,430 325 84.6 267	1,400 325 83.9 267	1,380 325 83.2 267			
+5	-6	(205) 1:37 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,550 322 87.4 266	1,520 322 85.7 266	1,490 322 84.8 266	1,460 322 84.0 267	1,430 322 83.2 267	1,410 322 82.6 267	1,390 322 81.8 267	1,370 322 81.2 267			
Std.	-11	(205) 1:37 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,540 319 84.9 266	1,510 319 83.9 266	1,480 319 83.1 266	1,450 319 82.3 267	1,420 319 81.6 267	1,400 319 80.8 267	1,370 319 80.1 267	1,350 319 79.6 267			
-5			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LES
Vno 275 KTS EA
ALT 13,000 F

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+9	(195) 1:49 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,360 297 88.5 237	1,370 304 88.5 243	1,370 311 88.5 250	1,370 316 88.5 254	1,380 321 88.5 259	1,380 325 88.5 262	1,380 328 88.5 265	1,380 331 88.5 268	1,380 334 88.5 270	1,380 336 88.5 272
+15	+4	(205) 1:45 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 301 88.5 243	1,430 309 88.5 250	1,430 315 88.5 255	1,430 320 88.5 260	1,430 325 88.5 264	1,430 328 88.5 267	1,430 332 88.5 270	1,430 335 88.5 273	1,430 338 88.5 276	1,430 340 88.5 278	1,430 342 88.5 280
+10	-1	(133) 1:41 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 313 88.5 256	1,490 319 88.5 260	1,490 324 88.5 265	1,490 328 88.5 269	1,490 332 88.5 273	1,490 336 88.5 276	1,490 339 88.5 279	1,490 341 88.5 281	1,490 341 86.4 282	1,470 341 85.6 282	1,450 341 85.0 282
+5	-6	(167) 1:37 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,550 323 88.5 267	1,550 328 88.5 271	1,550 332 88.5 274	1,550 336 88.5 279	1,560 338 87.6 281	1,530 338 85.9 281	1,510 338 85.2 281	1,490 338 84.6 281	1,470 338 84.0 282	1,450 338 83.6 282	1,440 338 83.1 282
Std.	-11	(196) 1:32 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,620 331 88.5 276	1,620 335 88.5 280	1,590 335 86.4 280	1,560 335 85.6 281	1,540 335 84.8 281	1,510 335 84.1 281	1,490 335 83.6 281	1,470 335 83.0 281	1,450 335 82.3 282	1,430 335 81.9 282	1,420 335 81.2 282
-5			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-20			GROSS/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 14,000 FT

°C EV. ROM D. EMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+20	+7	(152)	FF/Eng. #/Hr.		1,330	1,330	1,340	1,340	1,340	1,330				
		1:52	TAS Kts.		293	302	309	315	320	321				
		(145)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5				
		1:53	IAS Kts.		230	238	244	249	253	255				
+15	+2	(176)	FF/Eng. #/Hr.	1,380	1,390	1,390	1,390	1,370	1,340	1,310				
		1:48	TAS Kts.	298	307	314	319	319	319	319				
		(145)	% RPM	88.5	88.5	88.5	88.5	86.8	85.5	84.6				
		1:55	IAS Kts.	236	244	250	255	255	255	255				
+10	-3	(197)	FF/Eng. #/Hr.	1,440	1,440	1,410	1,380	1,350	1,330	1,300				
		1:44	TAS Kts.	310	316	316	316	316	316	316				
		(145)	% RPM	88.5	86.8	85.3	84.4	83.6	82.8	81.9				
		1:56	IAS Kts.	249	254	254	255	255	255	255				
+5	-8	(205)	FF/Eng. #/Hr.	1,460	1,430	1,400	1,370	1,340	1,310	1,290				
		1:43	TAS Kts.	313	313	313	313	313	313	313				
		(145)	% RPM	85.2	84.1	83.2	82.2	81.3	80.5	79.8				
		1:56	IAS Kts.	254	254	254	255	255	255	255				
Std.	-13	(205)	FF/Eng. #/Hr.	1,450	1,410	1,380	1,350	1,320	1,300	1,270				
		1:44	TAS Kts.	310	310	310	310	310	310	310				
		(145)	% RPM	83.5	82.6	81.6	80.8	79.9	79.0	78.2				
		1:58	IAS Kts.	254	254	254	255	255	255	255				
-5	-18	(205)	FF/Eng. #/Hr.	1,430	1,400	1,370	1,340	1,310	1,290	1,260				
		1:45	TAS Kts.	307	307	307	307	307	307	307				
		(145)	% RPM	82.3	81.3	80.3	79.4	78.6	77.7	77.0				
		1:59	IAS Kts.	254	254	254	255	255	255	255				
-10	-23	(205)	FF/Eng. #/Hr.	1,420	1,380	1,350	1,330	1,300	1,270	1,250				
		1:46	TAS Kts.	304	304	304	304	304	304	304				
		(145)	% RPM	82.2	81.3	80.4	79.5	78.7	78.0	77.3				
		2:00	IAS Kts.	254	254	254	255	255	255	255				
-15	-28	(205)	FF/Eng. #/Hr.	1,400	1,370	1,340	1,310	1,280	1,260	1,230				
		1:47	TAS Kts.	301	301	301	301	301	301	301				
		(145)	% RPM	81.6	80.7	79.8	79.0	78.2	77.4	76.6				
		2:01	IAS Kts.	254	254	254	255	255	255	255				
-20	-33	(205)	FF/Eng. #/Hr.	1,390	1,360	1,330	1,300	1,270	1,240	1,220				
		1:48	TAS Kts.	298	298	298	298	298	298	298				
		(145)	% RPM	80.9	80.0	79.2	78.3	77.5	76.7	76.0				
		2:03	IAS Kts.	254	254	254	255	255	255	255				
-25	-38	(205)	FF/Eng. #/Hr.	1,370	1,340	1,310	1,280	1,260	1,230	1,210				
		1:50	TAS Kts.	295	295	295	295	295	295	295				
		(145)	% RPM	80.5	79.6	78.8	77.9	77.1	76.4	75.6				
		2:04	IAS Kts.	254	254	254	255	255	255	255				
-30	-43	(205)	FF/Eng. #/Hr.	1,360	1,330	1,300	1,270	1,240	1,220	1,190				
		1:50	TAS Kts.	292	292	292	292	292	292	292				
		(145)	% RPM	80.4	79.5	78.7	77.9	77.0	76.3	75.6				
		2:06	IAS Kts.	254	254	254	255	255	255	255				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 14,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+7	(195) 1:53 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,330 293 88.5 230	1,330 302 88.5 238	1,340 309 88.5 244	1,340 315 88.5 249	1,340 320 88.5 253	1,350 325 88.5 258	1,350 329 88.5 261			
+15	+2	(140) 1:47 (135) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 298 88.5 236	1,390 307 88.5 244	1,390 314 88.5 250	1,390 319 88.5 255	1,390 324 88.5 259	1,400 329 88.5 263	1,400 332 88.5 266	1,400 334 88.3 268			
+10	-3	(168) 1:44 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 310 88.5 249	1,440 317 88.5 255	1,450 323 88.5 260	1,450 328 88.5 265	1,450 331 87.3 268	1,430 331 85.8 268	1,400 331 85.0 268	1,380 331 84.4 268			
+5	-8	(193) 1:39 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IA SKts.	1,510 321 88.5 261	1,510 327 88.5 266	1,490 328 86.4 267	1,460 328 85.2 268	1,440 328 84.4 268	1,410 328 83.7 268	1,390 328 83.0 268	1,370 328 82.3 268			
Std.	-13	(205) 1:37 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,540 325 86.4 267	1,510 325 85.2 267	1,480 325 84.3 267	1,450 325 83.4 268	1,420 325 82.6 268	1,400 325 81.8 268	1,380 325 81.2 268	1,350 325 80.4 268			
-5	-18	(205) 1:39 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,520 322 84.6 267	1,490 322 83.8 267	1,460 322 82.9 267	1,430 322 82.1 268	1,410 322 81.2 268	1,380 322 80.5 268	1,360 322 79.8 268	1,340 322 79.1 268			
-10	-23	(205) 1:39 (135) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,510 319 84.1 267	1,470 319 83.3 267	1,440 319 82.5 267	1,420 319 81.8 268	1,390 319 81.0 268	1,370 319 80.3 268	1,350 319 79.7 268	1,330 319 79.0 268			
-15	-28	(205) 1:41 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 316 83.4 267	1,460 316 82.6 267	1,430 316 81.8 267	1,400 316 81.0 268	1,380 316 80.3 268	1,350 316 79.6 268	1,330 316 78.9 268	1,310 316 78.3 268			
-20	-33	(205) 1:42 (135) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 312 82.7 267	1,440 312 81.9 267	1,420 312 81.1 267	1,390 312 80.3 268	1,360 312 79.6 268	1,340 312 78.9 268	1,320 312 78.3 268	1,300 312 77.7 268			
-25	-38	(205) 1:43 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,460 309 82.2 267	1,430 309 81.5 267	1,400 309 80.8 267	1,370 309 80.0 268	1,350 309 79.3 268	1,320 309 78.6 268	1,300 309 78.0 268	1,280 309 77.4 268			
-30	-43	(205) 1:44 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 306 82.0 267	1,420 306 81.3 267	1,390 306 80.6 267	1,360 306 79.9 268	1,340 306 79.2 268	1,310 306 78.6 268	1,290 306 77.9 268	1,270 306 77.3 268			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Vno 275 KTS EAS
ALT 14,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+7	(195) 1:53 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,330 293 88.5 230	1,330 302 88.5 238	1,340 309 88.5 244	1,340 315 88.5 249	1,340 320 88.5 253	1,350 325 88.5 258	1,350 329 88.5 261	1,350 332 88.5 265	1,350 335 88.5 267	1,340 337 88.5 269
+15	+2	(205) 1:49 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 298 88.5 236	1,390 307 88.5 244	1,390 314 88.5 250	1,390 319 88.5 255	1,390 324 88.5 259	1,400 329 88.5 263	1,400 332 88.5 266	1,400 336 88.5 269	1,400 339 88.5 272	1,400 341 88.5 275	1,400 343 88.5 276
+10	-3	(111) 1:43 (105) 1:43	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 310 88.5 249	1,440 317 88.5 255	1,450 323 88.5 260	1,450 328 88.5 265	1,450 332 88.5 268	1,460 336 88.5 272	1,460 339 88.5 275	1,460 342 88.5 277	1,460 345 88.5 281	1,460 347 88.5 282	1,460 347 86.2 282
+5	-8	(150) 1:39 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,510 321 88.5 261	1,510 327 88.5 266	1,510 332 88.5 270	1,520 336 88.5 275	1,520 340 88.5 278	1,520 343 88.5 281	1,510 344 87.2 281	1,490 344 85.7 281	1,480 344 85.2 282	1,460 344 84.5 282	1,440 344 84.1 282
Std.	-13	(181) 1:35 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,580 331 88.5 272	1,580 335 88.5 276	1,580 339 88.5 279	1,570 341 87.8 281	1,540 341 86.2 281	1,520 341 85.3 281	1,490 341 84.6 281	1,470 341 84.0 281	1,460 341 83.4 282	1,440 341 83.0 282	1,420 341 82.5 282
-5	-18	(205) 1:31 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,640 338 88.5 280	1,610 338 87.6 280	1,580 338 85.9 280	1,550 338 85.2 281	1,520 338 84.4 281	1,500 338 83.9 281	1,480 338 83.2 281	1,460 338 82.6 281	1,440 338 81.9 282	1,420 338 81.6 282	1,410 338 81.1 282
-10	-23	(205) 1:32 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,620 334 86.4 280	1,590 334 85.8 280	1,560 334 85.1 280	1,530 334 84.5 281	1,510 334 83.9 281	1,480 334 83.3 281	1,460 334 82.7 281	1,440 334 82.2 281	1,420 334 81.7 282	1,410 334 81.3 282	1,390 334 80.9 282
-15	-28	(205) 1:34 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,600 331 85.7 280	1,570 331 85.0 280	1,550 331 84.2 280	1,520 331 83.6 281	1,490 331 83.0 281	1,470 331 82.4 281	1,450 331 81.8 281	1,430 331 81.4 281	1,410 331 80.9 282	1,390 331 80.5 282	1,380 331 80.1 282
-20	-33	(205) 1:34 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,590 328 85.0 280	1,560 328 84.2 280	1,530 328 83.6 280	1,500 328 83.0 281	1,480 328 82.4 281	1,450 328 81.8 281	1,430 328 81.2 281	1,410 328 80.7 281	1,390 328 80.2 282	1,380 328 79.8 282	1,360 328 79.4 282
-25	-38	(205) 1:35 (105) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 324 84.6 280	1,540 324 83.9 280	1,520 324 83.2 280	1,490 324 82.6 281	1,460 324 82.0 281	1,440 324 81.4 281	1,420 324 80.9 281	1,400 324 80.4 281	1,380 324 79.9 282	1,360 324 79.4 282	1,350 324 79.0 282
-30	-43	(205) 1:36 (105) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,560 321 84.5 280	1,530 321 83.9 280	1,500 321 83.2 280	1,480 321 82.6 281	1,450 321 82.0 281	1,430 321 81.3 281	1,410 321 80.8 281	1,390 321 80.2 281	1,370 321 79.7 282	1,350 321 79.3 282	1,330 321 78.8 282

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 15,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+5	(185) 1:55 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,300 301 88.5 233	1,300 308 88.5 240	1,300 315 88.5 246	1,310 320 88.5 250	1,310 325 88.5 254				
+15	0	(164) 1:50 (145) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,350 304 88.5 237	1,350 312 88.5 244	1,360 318 88.5 250	1,360 324 88.5 255	1,340 324 87.2 255	1,320 324 85.6 255				
+10	-5	(186) 1:47 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,410 307 88.5 243	1,410 315 88.5 249	1,410 321 87.6 254	1,380 321 85.7 255	1,350 321 84.7 255	1,330 321 83.8 255	1,300 321 82.9 255				
+5	-10	(205) 1:42 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 318 87.1 254	1,430 318 85.3 254	1,400 318 84.4 254	1,370 318 83.3 255	1,340 318 82.4 255	1,310 318 81.7 255	1,290 318 80.9 255				
Std.	-15	(205) 1:44 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 315 84.7 254	1,420 315 83.6 254	1,390 315 82.5 254	1,360 315 81.7 255	1,330 315 80.8 255	1,300 315 79.9 255	1,270 315 79.1 255				
-5	-20	(205) 1:44 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 312 83.5 254	1,400 312 82.3 254	1,370 312 81.4 254	1,340 312 80.4 255	1,310 312 79.5 255	1,290 312 78.7 255	1,260 312 77.9 255				
-10	-25	(205) 1:46 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 309 83.0 254	1,390 309 82.0 254	1,360 309 81.2 254	1,330 309 80.3 255	1,300 309 79.5 255	1,270 309 78.7 255	1,250 309 78.0 255				
-15	-30	(205) 1:47 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,410 306 82.3 254	1,370 306 81.5 254	1,340 306 80.6 254	1,310 306 79.8 255	1,280 306 79.0 255	1,260 306 78.2 255	1,240 306 77.5 255				
-20	-35	(205) 1:48 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,390 302 81.7 254	1,360 302 80.8 254	1,330 302 79.9 254	1,300 302 79.0 255	1,270 302 78.3 255	1,250 302 77.6 255	1,220 302 76.8 255				
-25	-40	(205) 1:49 (145) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 299 81.3 254	1,340 299 80.3 254	1,310 299 79.5 254	1,280 299 78.7 255	1,260 299 78.0 255	1,230 299 77.2 255	1,210 299 76.5 255				
-30	-45	(205) 1:50 (145) 2:06	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 296 81.1 254	1,330 296 80.2 254	1,300 296 79.4 254	1,270 296 78.6 255	1,240 296 77.8 255	1,220 296 77.1 255	1,190 296 76.4 255				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 15,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+20	+5	(185)	FF/Eng. #/Hr.			1,300	1,300	1,300	1,310	1,310	1,310			
		1:56	TAS Kts.			301	308	315	320	325	329			
		(135)	% RPM			88.5	88.5	88.5	88.5	88.5	88.5			
		1:55	IAS Kts.			233	240	246	250	254	257			
+15	0	(195)	FF/Eng. #/Hr.		1,350	1,350	1,360	1,360	1,360	1,360	1,370			
		1:51	TAS Kts.		304	312	318	324	328	332	336			
		(135)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5	88.5			
		1:49	IAS Kts.		237	244	250	255	259	262	265			
+10	-5	(153)	FF/Eng. #/Hr.	1,410	1,410	1,420	1,420	1,420	1,420	1,410	1,390			
		1:46	TAS Kts.	307	315	322	327	332	336	336	336			
		(135)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	87.2	85.6			
		1:48	IAS Kts.	243	249	255	260	264	267	267	267			
+5	-10	(179)	FF/Eng. #/Hr.	1,470	1,470	1,470	1,470	1,450	1,420	1,390	1,370			
		1:42	TAS Kts.	318	325	330	333	333	333	333	333			
		(135)	% RPM	88.5	88.5	88.5	87.2	85.7	84.9	84.1	83.5			
		1:49	IAS Kts.	254	260	264	268	268	268	268	268			
Std.	-15	(202)	FF/Eng. #/Hr.	1,530	1,510	1,480	1,450	1,430	1,400	1,380	1,350			
		1:38	TAS Kts.	329	330	330	330	330	330	330	330			
		(135)	% RPM	88.5	86.9	85.3	84.4	83.6	82.8	82.1	81.4			
		1:51	IAS Kts.	266	267	267	268	268	268	268	268			
-5	-20	(205)	FF/Eng. #/Hr.	1,530	1,500	1,460	1,440	1,410	1,380	1,360	1,340			
		1:38	TAS Kts.	327	327	327	327	327	327	327	327			
		(135)	% RPM	85.8	84.8	83.7	82.8	82.0	81.2	80.6	80.0			
		1:52	IAS Kts.	267	267	267	268	268	268	268	268			
-10	-25	(205)	FF/Eng. #/Hr.	1,510	1,480	1,450	1,420	1,390	1,370	1,350	1,330			
		1:39	TAS Kts.	324	324	324	324	324	324	324	324			
		(135)	% RPM	85.0	84.2	83.4	82.6	81.9	81.2	80.6	80.0			
		1:53	IAS Kts.	267	267	267	268	268	268	268	268			
-15	-30	(205)	FF/Eng. #/Hr.	1,500	1,470	1,440	1,410	1,380	1,350	1,330	1,310			
		1:40	TAS Kts.	320	320	320	320	320	320	320	320			
		(135)	% RPM	84.4	83.4	82.6	81.8	81.1	80.4	79.7	79.1			
		1:55	IAS Kts.	267	267	267	268	268	268	268	268			
-20	-35	(205)	FF/Eng. #/Hr.	1,480	1,450	1,420	1,390	1,370	1,340	1,320	1,300			
		1:41	TAS Kts.	317	317	317	317	317	317	317	317			
		(135)	% RPM	83.6	82.7	82.0	81.2	80.5	79.8	79.2	78.5			
		1:55	IAS Kts.	267	267	267	268	268	268	268	268			
-25	-40	(205)	FF/Eng. #/Hr.	1,460	1,430	1,400	1,380	1,350	1,320	1,300	1,280			
		1:43	TAS Kts.	314	314	314	314	314	314	314	314			
		(135)	% RPM	83.1	82.4	81.6	80.9	80.2	79.5	78.8	78.3			
		1:57	IAS Kts.	267	267	267	268	268	268	268	268			
-30	-45	(205)	FF/Eng. #/Hr.	1,450	1,420	1,390	1,360	1,340	1,310	1,290	1,270			
		1:44	TAS Kts.	310	310	310	310	310	310	310	310			
		(135)	% RPM	82.9	82.2	81.4	80.7	80.1	79.4	78.8	78.3			
		1:58	IAS Kts.	267	267	267	268	268	268	268	268			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 16,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+3	(185) 1:58 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,270 296 88.5 225	1,280 306 88.5 234	1,280 314 88.5 241	1,280 320 88.5 245	1,280 325 88.5 249				
+15	-2	(152) 1:54 (145) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,320 301 88.5 231	1,330 310 88.5 238	1,330 317 88.5 245	1,330 323 88.5 250	1,330 328 88.5 254	1,320 329 87.1 255				
+10	-7	(175) 1:48 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 304 88.5 236	1,380 313 88.5 243	1,380 321 88.5 250	1,390 326 88.5 255	1,350 326 86.2 255	1,330 326 85.1 255	1,300 326 84.2 255				
+5	-12	(196) 1:44 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 316 88.5 249	1,430 323 88.0 254	1,400 323 85.9 254	1,370 323 84.8 255	1,340 323 83.9 255	1,310 323 83.0 255	1,290 323 82.1 255				
Std.	-17	(205) 1:43 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,460 320 85.8 254	1,420 320 84.8 254	1,390 320 83.7 254	1,360 320 82.7 255	1,330 320 81.6 255	1,300 320 80.8 255	1,280 320 80.0 255				
-5	-22	(205) 1:44 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 317 84.4 255	1,400 317 83.5 255	1,370 317 82.4 255	1,340 317 81.4 256	1,310 317 80.5 256	1,290 317 79.6 256	1,260 317 78.8 256				
-10	-27	(205) 1:46 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 314 84.0 255	1,390 314 83.0 255	1,360 314 82.2 255	1,330 314 81.3 256	1,300 314 80.4 256	1,270 314 79.7 256	1,250 314 78.9 256				
-15	-32	(205) 1:47 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,410 311 83.0 255	1,380 311 82.2 255	1,340 311 81.4 255	1,310 311 80.5 256	1,290 311 79.7 256	1,260 311 79.0 256	1,230 311 78.2 256				
-20	-37	(205) 1:48 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,390 307 82.6 255	1,360 307 81.7 255	1,330 307 80.9 255	1,300 307 80.1 256	1,270 307 79.4 256	1,250 307 78.6 256	1,220 307 77.8 256				
-25	-42	(205) 1:49 (145) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 304 82.1 255	1,350 304 81.3 255	1,320 304 80.4 255	1,290 304 79.7 256	1,260 304 78.9 256	1,230 304 78.2 256	1,210 304 77.4 256				
-30	-47	(205) 1:50 (145) 2:06	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 301 81.8 255	1,330 301 81.0 255	1,300 301 80.1 255	1,270 301 79.3 256	1,240 301 78.6 256	1,220 301 77.8 256	1,190 301 77.1 256				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Vno 275 KTS EAS
ALT 15,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+5	(185) 1:56 (105) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,300 301 88.5 233	1,300 308 88.5 240	1,300 315 88.5 246	1,310 320 88.5 250	1,310 325 88.5 254	1,310 329 88.5 257	1,310 332 88.5 260	1,310 335 88.5 263	1,310 338 88.5 266
+15	0	(195) 1:51 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,350 304 88.5 237	1,350 312 88.5 244	1,360 318 88.5 250	1,360 324 88.5 255	1,360 328 88.5 259	1,360 332 88.5 262	1,370 336 88.5 265	1,370 339 88.5 268	1,370 341 88.5 270	1,370 344 88.5 2
+10	-5	(205) 1:47 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,410 307 88.5 243	1,410 315 88.5 249	1,420 322 88.5 255	1,420 327 88.5 260	1,420 332 88.5 264	1,420 336 88.5 267	1,420 339 88.5 270	1,420 343 88.5 273	1,420 345 88.5 276	1,420 348 88.5 278	1,420 350 88.5 280
+5	-10	(130) 1:41 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 318 88.5 254	1,470 325 88.5 260	1,470 330 88.5 264	1,470 335 88.5 270	1,480 339 88.5 273	1,480 343 88.5 277	1,480 346 88.5 279	1,480 349 88.5 281	1,480 350 88.0 283	1,460 350 86.6 283	1,450 350 85.7 283
Std.	-15	(162) 1:37 (105) 1:45	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 329 88.5 266	1,540 334 88.5 270	1,540 338 88.5 274	1,540 342 88.5 278	1,540 346 88.5 281	1,530 346 87.6 281	1,500 346 85.9 281	1,480 346 85.3 281	1,460 346 84.7 282	1,440 346 84.1 282	1,430 346 83.7 282
-5	-20	(193) 1:33 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,600 338 88.5 276	1,610 342 88.5 280	1,590 343 88.0 281	1,560 343 86.0 282	1,530 343 85.4 282	1,510 343 84.7 282	1,490 343 84.1 282	1,460 343 83.4 282	1,450 343 82.9 283	1,430 343 82.4 283	1,410 343 81.8 283
-10	-25	(205) 1:32 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,630 340 87.7 281	1,600 340 86.9 281	1,570 340 86.2 281	1,540 340 85.5 282	1,520 340 84.8 282	1,490 340 84.2 282	1,470 340 83.6 282	1,450 340 83.0 282	1,430 340 82.6 283	1,410 340 82.1 283	1,400 340 81.7 283
-15	-30	(205) 1:33 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,610 336 86.8 281	1,580 336 86.0 281	1,550 336 85.2 281	1,520 336 84.6 282	1,500 336 83.9 282	1,470 336 83.3 282	1,450 336 82.8 282	1,430 336 82.2 282	1,410 336 81.8 283	1,400 336 81.3 283	1,380 336 80.9 283
-20	-35	(205) 1:34 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,600 333 86.2 281	1,570 333 85.4 281	1,540 333 84.6 281	1,510 333 84.0 282	1,480 333 83.3 282	1,460 333 82.7 282	1,440 333 82.2 282	1,420 333 81.6 282	1,400 333 81.1 283	1,380 333 80.7 283	1,360 333 80.3 283
-25	-40	(205) 1:35 (105) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,580 329 85.7 281	1,550 329 85.0 281	1,520 329 84.3 281	1,500 329 83.6 282	1,470 329 82.9 282	1,450 329 82.3 282	1,420 329 81.7 282	1,400 329 81.2 282	1,380 329 80.7 283	1,360 329 80.2 283	1,350 329 79.8
-30	-45	(205) 1:36 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 326 85.6 281	1,540 326 84.8 281	1,510 326 84.1 281	1,480 326 83.4 282	1,460 326 82.8 282	1,440 326 82.2 282	1,410 326 81.7 282	1,390 326 81.1 282	1,370 326 80.6 283	1,360 326 80.1 283	1,340 326 79.6 283

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 16,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+3	(185) 1:58 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,270 296 88.5 225	1,280 306 88.5 234	1,280 314 88.5 241	1,280 320 88.5 245	1,280 325 88.5 249	1,280 329 88.5 253			
+15	-2	(195) 1:54 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,320 301 88.5 231	1,330 310 88.5 238	1,330 317 88.5 245	1,330 323 88.5 250	1,330 328 88.5 254	1,340 333 88.5 258	1,340 336 88.5 261			
+10	-7	(139) 1:48 (135) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 304 88.5 236	1,380 313 88.5 243	1,380 321 88.5 250	1,390 327 88.5 256	1,390 332 88.5 260	1,390 336 88.5 263	1,390 340 88.5 267	1,390 342 87.8 268			
+5	-12	(166) 1:44 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 316 88.5 249	1,440 324 88.5 255	1,440 330 88.5 260	1,450 335 88.5 265	1,460 339 88.5 268	1,430 339 86.9 268	1,400 339 85.4 268	1,370 339 84.8 268			
Std.	-17	(191) 1:40 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 328 88.5 261	1,500 334 88.5 266	1,490 335 87.3 267	1,460 335 85.7 268	1,430 335 84.8 268	1,400 335 83.9 268	1,380 335 83.1 268	1,360 335 82.4 268			
-5	-22	(205) 1:37 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,540 332 88.2 267	1,500 332 85.9 267	1,470 332 84.9 267	1,440 332 84.0 268	1,410 332 83.1 268	1,390 332 82.3 268	1,360 332 81.6 268	1,340 332 81.0 268			
-10	-27	(205) 1:39 (135) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,520 329 85.9 267	1,480 329 85.0 267	1,450 329 84.2 267	1,420 329 83.4 268	1,400 329 82.8 268	1,370 329 82.1 268	1,350 329 81.6 268	1,330 329 80.9 268			
-15	-32	(205) 1:40 (135) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 325 85.0 267	1,470 325 84.3 267	1,440 325 83.6 267	1,410 325 82.8 268	1,380 325 82.1 268	1,360 325 81.5 268	1,330 325 80.8 268	1,310 325 80.2 268			
-20	-37	(205) 1:41 (135) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 322 84.4 267	1,450 322 83.6 267	1,420 322 82.9 267	1,390 322 82.2 268	1,370 322 81.5 268	1,340 322 80.9 268	1,320 322 80.3 268	1,300 322 79.7 268			
-25	-42	(205) 1:42 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 319 84.1 267	1,440 319 83.4 267	1,410 319 82.6 267	1,380 319 81.9 268	1,350 319 81.1 268	1,330 319 80.5 268	1,310 319 79.8 268	1,280 319 79.3 268			
-30	-47	(205) 1:44 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 315 83.8 267	1,420 315 83.1 267	1,390 315 82.4 267	1,360 315 81.7 268	1,340 315 81.0 268	1,310 315 80.3 268	1,290 315 79.7 268	1,270 315 79.1 268			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Vmo 275 KTS EAS
ALT 16,000 FT

C DEV. ROM TD. EMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+3	(185) 1:58 (105) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,270 296 88.5 225	1,280 306 88.5 234	1,280 314 88.5 241	1,280 320 88.5 245	1,280 325 88.5 249	1,280 329 88.5 253	1,280 333 88.5 257	1,290 336 88.5 259	1,290 339 88.5 262
+15	-2	(195) 1:54 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,320 301 88.5 231	1,330 310 88.5 238	1,330 317 88.5 245	1,330 323 88.5 250	1,330 328 88.5 254	1,340 333 88.5 258	1,340 336 88.5 261	1,340 340 88.5 265	1,340 342 88.5 267	1,340 346 88.5 269
+10	-7	(205) 1:49 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 304 88.5 236	1,380 313 88.5 243	1,380 321 88.5 250	1,390 327 88.5 256	1,390 332 88.5 260	1,390 336 88.5 263	1,390 340 88.5 267	1,390 344 88.5 270	1,390 346 88.5 273	1,390 349 88.5 275	1,390 351 88.5 277
+5	-12	(109) 1:44 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 316 88.5 249	1,440 324 88.5 255	1,440 330 88.5 260	1,450 335 88.5 265	1,450 339 88.5 269	1,450 343 88.5 272	1,450 347 88.5 276	1,450 350 88.5 278	1,450 352 88.5 281	1,450 355 88.5 283	1,450 355 88.5 283
Std.	-17	(145) 1:40 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 328 88.5 261	1,500 334 88.5 266	1,500 338 88.5 269	1,510 343 88.5 275	1,510 347 88.5 278	1,510 350 88.5 281	1,510 352 88.5 282	1,490 352 87.3 282	1,470 352 85.9 283	1,450 352 85.3 283	1,430 352 84.8 283
-5	-22	(177) 1:35 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,580 338 88.5 272	1,580 342 88.5 276	1,580 346 88.5 279	1,570 349 88.5 282	1,540 349 87.5 282	1,520 349 85.9 282	1,490 349 85.2 282	1,470 349 84.5 282	1,450 349 84.0 283	1,430 349 83.5 283	1,420 349 83.0 283
-10	-27	(205) 1:30 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,640 345 88.5 281	1,610 345 88.1 281	1,580 345 87.2 281	1,550 345 86.4 282	1,530 345 85.7 282	1,500 345 85.0 282	1,480 345 84.4 282	1,460 345 83.9 282	1,440 345 83.4 283	1,420 345 83.0 283	1,400 345 82.6 283
-15	-32	(205) 1:32 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,620 342 88.0 281	1,590 342 87.2 281	1,560 342 86.4 281	1,540 342 85.6 282	1,510 342 84.8 282	1,480 342 84.2 282	1,460 342 83.6 282	1,440 342 83.1 282	1,420 342 82.6 283	1,400 342 82.2 283	1,380 342 81.8 283
-20	-37	(205) 1:33 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,610 338 87.4 281	1,580 338 86.6 281	1,550 338 85.8 281	1,520 338 85.0 282	1,490 338 84.3 282	1,470 338 83.7 282	1,450 338 83.1 282	1,420 338 82.6 282	1,410 338 82.1 283	1,390 338 81.6 283	1,370 338 81.2 283
-25	-42	(205) 1:34 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,590 334 86.9 281	1,560 334 86.1 281	1,530 334 85.4 281	1,500 334 84.6 282	1,480 334 84.0 282	1,450 334 83.3 282	1,430 334 82.8 282	1,410 334 82.2 282	1,390 334 81.7 283	1,370 334 81.2 283	1,360 334 80.8 283
-30	-47	(205) 1:35 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,580 331 86.6 281	1,550 331 85.7 281	1,520 331 84.9 281	1,490 331 84.2 282	1,460 331 83.7 282	1,440 331 83.2 282	1,420 331 82.6 282	1,400 331 82.1 282	1,380 331 81.6 283	1,360 331 81.1 283	1,340 331 80.6 283

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 17,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+1	(185) 2:01 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 294 88.5 220	1,240 304 88.5 229	1,240 312 88.5 235	1,250 319 88.5 241	1,250 325 88.5 245				
+15	-4	(195) 1:56 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,290 296 88.5 224	1,290 307 88.5 232	1,290 315 88.5 240	1,300 322 88.5 245	1,300 328 88.5 250	1,300 332 88.5 253				
+10	-9	(162) 1:51 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,340 311 88.5 238	1,340 319 88.5 244	1,350 325 88.5 251	1,350 331 88.5 255	1,330 332 86.5 256	1,300 332 85.5 256				
+5	-14	(184) 1:47 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 312 88.5 241	1,410 322 88.5 249	1,410 329 88.5 255	1,370 329 86.2 256	1,340 329 85.1 256	1,310 329 84.1 256	1,290 329 83.2 256				
Std.	-19	(205) 1:42 (195) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 326 88.5 255	1,430 326 85.9 255	1,400 326 84.9 255	1,360 326 83.9 256	1,330 326 82.8 256	1,300 326 82.0 256	1,280 326 81.1 256				
-5	-24	(205) 1:44 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 322 85.4 255	1,410 322 84.4 255	1,370 322 83.4 255	1,340 322 82.3 256	1,310 322 81.4 256	1,290 322 80.6 256	1,260 322 79.6 256				
-10	-29	(205) 1:45 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,430 319 84.8 255	1,400 319 83.9 255	1,360 319 83.0 255	1,330 319 82.1 256	1,300 319 81.2 256	1,270 319 80.4 256	1,250 319 79.6 256				
-15	-34	(205) 1:46 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 316 83.8 255	1,380 316 82.9 255	1,350 316 82.1 255	1,320 316 81.3 256	1,290 316 80.5 256	1,260 316 79.8 256	1,240 316 79.1 256				
-20	-39	(205) 1:47 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 312 83.4 255	1,360 312 82.5 255	1,330 312 81.6 255	1,300 312 80.8 256	1,270 312 79.9 256	1,250 312 79.2 256	1,220 312 78.4 256				
-25	-44	(205) 1:48 (145) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,390 310 83.0 255	1,350 310 82.0 255	1,320 310 81.2 255	1,290 310 80.3 256	1,260 310 79.6 256	1,240 310 78.8 256	1,210 310 78.2 256				
-30	-49	(205) 1:50 (145) 2:05	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,370 306 82.8 255	1,340 306 81.9 255	1,310 306 81.0 255	1,280 306 80.2 256	1,250 306 79.4 256	1,220 306 78.6 256	1,200 306 77.9 256				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 17,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	+1	(185) 2:01 (135) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 294 88.5 220	1,240 304 88.5 229	1,240 312 88.5 235	1,250 319 88.5 241	1,250 325 88.5 245	1,250 329 88.5 249			
+15	-4	(195) 1:56 (135) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,290 296 88.5 224	1,290 307 88.5 232	1,290 315 88.5 240	1,300 322 88.5 245	1,300 328 88.5 250	1,300 332 88.5 253	1,300 336 88.5 256			
+10	-9	(195) 1:52 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,340 311 88.5 238	1,340 319 88.5 244	1,350 325 88.5 251	1,350 331 88.5 255	1,360 336 88.5 259	1,350 340 88.5 262	1,360 344 88.5 265			
+5	-14	(151) 1:47 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 312 88.5 241	1,410 322 88.5 249	1,410 329 88.5 255	1,410 334 88.5 260	1,410 339 88.5 264	1,410 343 88.5 267	1,400 345 87.6 269	1,380 345 85.9 269			
STD.	-19	(177) 1:42 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,460 327 88.5 256	1,470 333 88.5 261	1,470 338 88.5 265	1,470 346 88.3 273	1,440 346 86.2 273	1,410 346 85.1 273	1,390 346 84.3 273	1,360 346 83.6 273			
-5	-24	(201) 1:37 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,540 336 88.5 266	1,510 338 87.5 268	1,480 338 86.6 268	1,450 338 85.2 269	1,420 338 84.2 269	1,390 338 83.4 269	1,370 338 82.6 269	1,340 338 82.0 269			
-10	-29	(205) 1:38 (135) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 334 87.1 268	1,500 334 86.2 268	1,460 334 85.3 268	1,430 334 84.4 269	1,400 334 83.6 269	1,380 334 82.9 269	1,350 334 82.3 269	1,330 334 81.8 269			
-15	-34	(205) 1:39 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,510 331 86.1 268	1,480 331 85.3 268	1,450 331 84.5 268	1,420 331 83.7 269	1,390 331 83.0 269	1,360 331 82.3 269	1,340 331 81.7 269	1,320 331 81.0 269			
-20	-39	(205) 1:40 (135) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 327 85.6 268	1,460 327 84.6 268	1,430 327 83.8 268	1,400 327 83.0 269	1,370 327 82.2 269	1,350 327 81.6 269	1,330 327 81.0 269	1,300 327 80.4 269			
-25	-44	(205) 1:41 (135) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,480 324 85.1 268	1,450 324 84.3 268	1,420 324 83.5 268	1,390 324 82.7 269	1,360 324 82.0 269	1,330 324 81.3 269	1,310 324 80.7 269	1,290 324 80.1 269			
-30	-49	(205) 1:42 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,470 321 84.9 268	1,430 321 84.1 268	1,400 321 83.3 268	1,370 321 82.6 269	1,350 321 81.9 269	1,320 321 81.2 269	1,300 321 80.5 269	1,280 321 80.0 269			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & L
Vno 275 KTS
ALT 17,000

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+20	+1	(185)	FF/Eng. #/Hr.			1,240	1,240	1,240	1,250	1,250	1,250	1,250	1,250	1,25
		2:01	TAS Kts.			294	304	312	319	325	329	333	337	340
		(105)	% RPM			88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:00	IAS Kts.			220	229	235	241	245	249	253	256	258
+15	-4	(195)	FF/Eng. #/Hr.		1,290	1,290	1,290	1,300	1,300	1,300	1,300	1,300	1,300	1,300
		1:56	TAS Kts.		296	307	315	322	328	332	336	340	343	346
		(105)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		1:56	IAS Kts.		224	232	240	245	250	253	256	261	263	266
+10	-9	(195)	FF/Eng. #/Hr.		1,340	1,340	1,350	1,350	1,350	1,350	1,360	1,360	1,360	1,36
		1:52	TAS Kts.		311	319	325	331	336	340	344	347	350	352
		(105)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		1:50	IAS Kts.		238	244	251	255	259	262	265	269	272	[illegible]
+5	-14	(205)	FF/Eng. #/Hr.	1,400	1,410	1,410	1,410	1,410	1,410	1,410	1,420	1,420	1,420	1,4
		1:47	TAS Kts.	312	322	329	334	339	343	347	350	353	355	[illegible]
		(105)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		1:46	IAS Kts.	241	249	255	260	264	267	271	273	277	279	28
Std.	-19	(126)	FF/Eng. #/Hr.	1,460	1,470	1,470	1,470	1,470	1,470	1,480	1,480	1,480	1,460	1,44
		1:41	TAS Kts.	327	333	338	342	346	350	353	356	358	358	[illegible]
		(105)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	86.8	86.1
		1:44	IAS Kts.	256	261	265	269	273	276	279	281	284	284	[illegible]
-5	-24	(160)	FF/Eng. #/Hr.	1,540	1,540	1,540	1,540	1,540	1,540	1,510	1,490	1,460	1,440	1,4
		1:37	TAS Kts.	336	341	346	350	353	355	355	355	355	355	[illegible]
		(105)	% RPM	88.5	88.5	88.5	88.5	88.5	88.1	87.4	85.9	85.2	84.7	84.1
		1:45	IAS Kts.	266	270	274	279	281	283	283	283	284	284	284
-10	-29	(190)	FF/Eng. #/Hr.	1,620	1,620	1,600	1,570	1,540	1,510	1,490	1,470	1,450	1,430	1,4
		1:32	TAS Kts.	345	349	351	351	351	351	351	351	351	351	351
		(105)	% RPM	88.5	88.5	88.4	87.6	86.8	86.2	85.5	85.0	84.4	84.0	83.
		1:46	IAS Kts.	276	280	282	283	283	283	283	283	284	284	284
-15	-34	(198)	FF/Eng. #/Hr.	1,620	1,610	1,580	1,550	1,520	1,500	1,470	1,450	1,430	1,410	1,3
		1:32	TAS Kts.	345	347	347	347	347	347	347	347	347	347	347
		(105)	% RPM	88.5	88.4	87.5	86.7	86.0	85.3	84.6	84.1	83.6	83.1	82.
		1:48	IAS Kts.	280	282	282	283	283	283	283	283	284	284	284
-20	-39	(204)	FF/Eng. #/Hr.	1,620	1,590	1,560	1,530	1,510	1,480	1,450	1,430	1,410	1,400	1,380
		1:33	TAS Kts.	344	344	344	344	344	344	344	344	344	344	344
		(105)	% RPM	88.5	87.9	87.0	86.2	85.4	84.8	84.1	83.5	83.0	82.6	82.2
		1:49	IAS Kts.	282	282	282	283	283	283	283	283	284	284	284
-25	-44	(205)	FF/Eng. #/Hr.	1,610	1,580	1,550	1,520	1,490	1,470	1,440	1,420	1,400	1,380	1,360
		1:33	TAS Kts.	340	340	340	340	340	340	340	340	340	340	340
		(105)	% RPM	88.3	87.4	86.5	85.8	85.0	84.4	83.8	83.2	82.8	82.3	81.
		1:50	IAS Kts.	282	282	282	283	283	283	283	283	284	284	284
-30	-49	(205)	FF/Eng. #/Hr.	1,600	1,570	1,540	1,510	1,480	1,460	1,430	1,410	1,390	1,370	1,35
		1:34	TAS Kts.	337	337	337	337	337	337	337	337	337	337	337
		(105)	% RPM	88.3	87.2	86.4	85.6	84.9	84.3	83.8	83.2	82.6	82.3	81.7
		1:51	IAS Kts.	282	282	282	283	283	283	283	283	284	284	284

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 240 KTS EAS
ALT 18,000 FT

DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-1	(175) 2:04 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,210 301 88.5 223	1,210 310 88.5 230	1,210 318 88.5 236	1,220 324 88.5 241				
+15	-6	(185) 1:59 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 304 88.5 226	1,260 313 88.5 234	1,260 321 88.5 241	1,270 327 88.5 245	1,270 332 88.5 249				
+10	-11	(150) 1:54 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,300 308 88.5 232	1,310 317 88.5 240	1,310 324 88.5 246	1,320 330 88.5 251	1,320 335 88.5 255	1,300 338 87.8 257				
+5	-16	(172) 1:50 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 311 88.5 237	1,370 320 88.5 244	1,370 327 88.5 250	1,370 333 88.5 256	1,340 334 87.4 257	1,310 334 85.2 257	1,290 334 84.4 257				
Std.	-21	(194) 1:45 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,430 323 88.5 248	1,430 331 88.5 255	1,400 331 87.1 256	1,370 331 85.0 257	1,340 331 84.0 257	1,310 331 83.1 257	1,280 331 82.2 257				
-5	-26	(205) 1:44 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 328 87.4 256	1,420 328 85.6 256	1,380 328 84.6 256	1,350 328 83.5 257	1,320 328 82.4 257	1,290 328 81.6 257	1,270 328 80.6 257				
-10	-31	(205) 1:44 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 324 85.9 256	1,400 324 84.9 256	1,370 324 83.9 256	1,340 324 83.0 257	1,300 324 82.2 257	1,280 324 81.3 257	1,250 324 80.6 257				
-15	-36	(205) 1:46 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 321 84.8 256	1,390 321 83.9 256	1,350 321 83.0 256	1,320 321 82.2 257	1,290 321 81.4 257	1,260 321 80.6 257	1,240 321 79.9 257				
-20	-41	(205) 1:46 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,410 318 84.3 256	1,370 318 83.4 256	1,340 318 82.5 256	1,310 318 81.7 257	1,280 318 80.9 257	1,250 318 80.1 257	1,230 318 79.4 257				
-25	-46	(205) 1:47 (145) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 314 84.0 256	1,360 314 83.0 256	1,330 314 82.2 256	1,300 314 81.4 257	1,270 314 80.5 257	1,240 314 79.8 257	1,210 314 79.0 257				
-30	-51	(205) 1:49 (145) 2:05	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 311 83.7 256	1,350 311 82.8 256	1,310 311 81.9 256	1,280 311 81.0 257	1,250 311 80.2 257	1,230 311 79.4 257	1,200 311 78.7 257				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 18,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-1	(175) 2:04 (135) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,210 301 88.5 223	1,210 310 88.5 230	1,210 318 88.5 236	1,220 324 88.5 241	1,220 329 88.5 245			
+15	-6	(185) 1:59 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 304 88.5 226	1,260 313 88.5 234	1,260 321 88.5 241	1,270 327 88.5 245	1,270 332 88.5 249	1,270 336 88.5 253			
+10	-11	(195) 1:56 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,300 308 88.5 232	1,310 317 88.5 240	1,310 324 88.5 246	1,320 330 88.5 251	1,320 335 88.5 255	1,320 340 88.5 259	1,320 344 88.5 262			
+5	-16	(205) 1:50 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 311 88.5 237	1,370 320 88.5 244	1,370 327 88.5 250	1,370 333 88.5 256	1,370 338 88.5 260	1,380 343 88.5 264	1,380 347 88.5 267	1,380 350 88.5 269			
Std.	-21	(162) 1:44 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,430 323 88.5 248	1,430 331 88.5 255	1,430 336 88.5 260	1,430 341 88.5 265	1,440 346 88.5 269	1,420 347 87.3 270	1,390 347 85.6 270	1,370 347 85.0 270			
-5	-26	(187) 1:40 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 334 88.5 260	1,500 340 88.5 265	1,490 343 88.0 268	1,460 343 87.1 269	1,430 343 85.5 269	1,400 343 84.6 269	1,370 343 83.8 269	1,350 343 83.1 269			
-10	-31	(205) 1:37 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,540 340 88.4 268	1,510 340 87.4 268	1,470 340 86.4 268	1,440 340 85.5 269	1,410 340 84.7 269	1,380 340 83.9 269	1,360 340 83.2 269	1,340 340 82.7 269			
-15	-36	(205) 1:39 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,520 336 87.3 268	1,490 336 86.4 268	1,460 336 85.4 268	1,430 336 84.6 269	1,400 336 83.9 269	1,370 336 83.2 269	1,350 336 82.6 269	1,320 336 82.0 269			
-20	-41	(205) 1:39 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,510 333 86.8 268	1,470 333 85.8 268	1,440 333 84.9 268	1,410 333 84.0 269	1,380 333 83.3 269	1,360 333 82.6 269	1,330 333 82.0 269	1,310 333 81.3 269			
-25	-46	(205) 1:40 (135) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,500 329 86.3 268	1,460 329 85.5 268	1,430 329 84.6 268	1,400 329 83.8 269	1,370 329 83.0 269	1,340 329 82.2 269	1,320 329 81.6 269	1,290 329 80.9 269			
-30	-51	(205) 1:41 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,480 326 86.2 268	1,450 326 85.2 268	1,410 326 84.3 268	1,380 326 83.6 269	1,360 326 82.8 269	1,330 326 82.0 269	1,300 326 81.4 269	1,280 326 80.8 269			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Vno 275 KTS EAS
ALT 18,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-1	(175) 2:04 (105) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,210 301 88.5 223	1,210 310 88.5 230	1,210 316 88.5 236	1,220 324 88.5 241	1,220 329 88.5 245	1,220 333 88.5 249	1,220 337 88.5 252	1,220 340 88.5 [illegible]
+15	-6	(185) 1:59 (105) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 304 88.5 226	1,260 313 88.5 234	1,260 321 88.5 241	1,270 327 88.5 245	1,270 332 88.5 249	1,270 336 88.5 253	1,270 340 88.5 257	1,270 344 88.5 260	1,280 346 88.5 262
+10	-11	(195) 1:56 (105) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,300 308 88.5 232	1,310 317 88.5 240	1,310 324 88.5 246	1,320 330 88.5 251	1,320 335 88.5 255	1,320 340 88.5 259	1,320 344 88.5 262	1,330 347 88.5 265	1,330 350 88.5 268	1,330 353 88.5 270
+5	-16	(205) 1:50 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 311 88.5 237	1,370 320 88.5 244	1,370 327 88.5 250	1,370 333 88.5 256	1,370 338 88.5 260	1,380 343 88.5 264	1,380 347 88.5 267	1,380 350 88.5 269	1,380 353 88.5 273	1,380 356 88.5 275	1,380 358 88.5 277
STD.	-21	(205) 1:45 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,430 323 88.5 248	1,430 331 88.5 255	1,430 336 88.5 260	1,430 341 88.5 265	1,440 346 88.5 269	1,440 350 88.5 272	1,440 353 88.5 275	1,440 356 88.5 277	1,450 359 88.5 280	1,450 361 88.5 282	1,450 364 88.5 284
-5	-26	(140) 1:40 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 334 88.5 260	1,500 340 88.5 265	1,500 345 88.5 270	1,500 349 88.5 274	1,500 353 88.5 277	1,510 356 88.5 280	1,510 359 88.5 282	1,500 360 87.6 283	1,480 360 87.4 284	1,460 360 85.9 284	1,440 360 85.5 284
-10	-31	(172) 1:34 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 343 88.5 271	1,580 348 88.5 275	1,580 352 88.5 278	1,590 356 88.5 283	1,550 357 88.0 283	1,530 357 87.3 283	1,500 357 86.7 283	1,480 357 86.1 283	1,460 357 85.5 284	1,440 357 85.0 284	1,420 357 84.6 284
-15	-36	(182) 1:35 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 343 88.5 274	1,580 348 88.5 278	1,580 352 88.5 282	1,560 353 88.0 283	1,540 353 87.2 283	1,510 353 86.4 283	1,490 353 85.8 283	1,460 353 85.2 283	1,440 353 84.6 284	1,420 353 84.2 284	1,400 353 83.9 284
-20	-41	(189) 1:35 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 342 88.5 276	1,580 347 88.5 281	1,580 349 88.4 282	1,550 349 87.6 283	1,530 349 86.7 283	1,500 349 86.0 283	1,470 349 85.3 283	1,450 349 84.6 283	1,430 349 84.1 284	1,410 349 83.6 284	1,390 349 83.3 284
-25	-46	(191) 1:35 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 340 88.5 277	1,580 344 88.5 281	1,570 345 88.0 282	1,540 345 87.2 283	1,510 345 86.4 283	1,490 345 85.6 283	1,460 345 84.9 283	1,440 345 84.3 283	1,420 345 83.8 284	1,400 345 83.3 284	1,380 345 83.0 284
-30	-51	(192) 1:35 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,570 337 88.5 277	1,580 341 88.5 281	1,560 342 87.8 282	1,530 342 87.0 283	1,500 342 86.2 283	1,470 342 85.5 283	1,450 342 84.8 283	1,430 342 84.3 283	1,400 342 83.7 284	1,380 342 83.2 284	1,360 342 82.8 284

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 19,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-3	(175) 2:07 (145) 2:07	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,180 297 88.5 215	1,180 308 88.5 224	1,180 316 88.5 230	1,180 323 88.5 236				
+15	-8	(185) 2:03 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,220 300 88.5 219	1,230 311 88.5 229	1,230 319 88.5 235	1,230 326 88.5 241	1,230 331 88.5 245				
+10	-13	(185) 1:58 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,270 313 88.5 232	1,280 322 88.5 240	1,280 329 88.5 245	1,290 334 88.5 249	1,290 339 88.5 253				
+5	-18	(160) 1:52 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,330 316 88.5 236	1,330 325 88.5 244	1,340 332 88.5 251	1,340 338 88.5 255	1,320 340 87.4 257	1,290 340 85.7 257				
Std.	-23	(182) 1:48 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 319 88.5 241	1,390 328 88.5 249	1,390 335 88.5 254	1,370 336 87.2 257	1,340 336 85.3 257	1,310 336 84.4 257	1,280 336 83.3 257				
-5	-28	(202) 1:44 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 331 88.5 254	1,430 333 88.2 256	1,390 333 85.9 256	1,360 333 84.8 257	1,330 333 83.8 257	1,300 333 82.8 257	1,270 333 81.9 257				
-10	-33	(205) 1:44 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 330 87.0 256	1,410 330 86.0 256	1,380 330 85.0 256	1,340 330 84.1 257	1,310 330 83.3 257	1,280 330 82.4 257	1,260 330 81.7 257				
-15	-38	(205) 1:45 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,430 326 86.0 256	1,400 326 85.0 256	1,360 326 84.1 256	1,330 326 83.3 257	1,300 326 82.4 257	1,270 326 81.7 257	1,240 326 80.9 257				
-20	-43	(205) 1:46 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 323 85.5 256	1,380 323 84.4 256	1,340 323 83.5 256	1,310 323 82.6 257	1,280 323 81.8 257	1,250 323 80.9 257	1,230 323 80.2 257				
-25	-48	(205) 1:47 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 319 85.2 256	1,360 319 84.1 256	1,330 319 83.1 256	1,300 319 82.2 257	1,270 319 81.4 257	1,240 319 80.6 257	1,220 319 79.9 257				
-30	-53	(205) 1:48 (145) 2:05	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,390 316 84.9 256	1,350 316 83.9 256	1,320 316 83.0 256	1,290 316 82.0 257	1,260 316 81.2 257	1,230 316 80.4 257	1,200 316 79.7 257				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 19,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 105
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+20	-3	(175)	FF/Eng. #/Hr.				1,180	1,180	1,180	1,180	1,190			
		2:07	TAS Kts.				297	308	316	323	328			
		(135)	% RPM				88.5	88.5	88.5	88.5	88.5			
		2:06	IAS Kts.				215	224	230	236	239			
+15	-8	(185)	FF/Eng. #/Hr.			1,220	1,230	1,230	1,230	1,230	1,240			
		2:03	TAS Kts.			300	311	319	326	331	336			
		(135)	% RPM			88.5	88.5	88.5	88.5	88.5	88.5			
		2:01	IAS Kts.			219	229	235	241	245	248			
+10	-13	(185)	FF/Eng. #/Hr.			1,270	1,280	1,280	1,290	1,290	1,290			
		1:58	TAS Kts.			313	322	329	334	339	344			
		(135)	% RPM			88.5	88.5	88.5	88.5	88.5	88.5			
		1:56	IAS Kts.			232	240	245	249	253	257			
+5	-18	(195)	FF/Eng. #/Hr.		1,330	1,330	1,340	1,340	1,340	1,340	1,340			
		1:53	TAS Kts.		316	325	332	338	342	346	350			
		(135)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5	88.5			
		1:52	IAS Kts.		236	244	251	255	258	261	265			
Std.	-23	(140)	FF/Eng. #/Hr.	1,380	1,390	1,390	1,390	1,400	1,400	1,400	1,380			
		1:49	TAS Kts.	319	328	335	340	345	349	353	353			
		(135)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	88.4	86.4			
		1:49	IAS Kts.	241	249	254	259	263	266	270	270			
-5	-28	(172)	FF/Eng. #/Hr.	1,450	1,450	1,460	1,460	1,440	1,410	1,380	1,360			
		1:43	TAS Kts.	331	338	343	348	349	349	349	349			
		(135)	% RPM	88.5	88.5	88.5	88.5	88.3	86.2	85.2	84.4			
		1:50	IAS Kts.	254	260	264	269	270	270	270	270			
-10	-33	(197)	FF/Eng. #/Hr.	1,530	1,520	1,490	1,450	1,420	1,390	1,370	1,340			
		1:37	TAS Kts.	341	345	345	345	345	345	345	345			
		(135)	% RPM	88.5	88.3	87.7	86.6	85.8	85.0	84.4	83.8			
		1:52	IAS Kts.	265	269	269	270	270	270	270	270			
-15	-38	(203)	FF/Eng. #/Hr.	1,530	1,500	1,470	1,440	1,410	1,380	1,360	1,330			
		1:38	TAS Kts.	341	342	342	342	342	342	342	342			
		(135)	% RPM	88.5	87.7	86.6	85.8	85.0	84.3	83.6	82.9			
		1:53	IAS Kts.	268	269	269	270	270	270	270	270			
-20	-43	(205)	FF/Eng. #/Hr.	1,520	1,490	1,460	1,420	1,390	1,370	1,340	1,320			
		1:39	TAS Kts.	338	338	338	338	338	338	338	338			
		(135)	% RPM	88.2	87.1	86.1	85.2	84.4	83.6	82.8	82.2			
		1:54	IAS Kts.	269	269	269	270	270	270	270	270			
-25	-48	(205)	FF/Eng. #/Hr.	1,510	1,470	1,440	1,410	1,360	1,350	1,320	1,300			
		1:39	TAS Kts.	335	335	335	335	335	335	335	335			
		(135)	% RPM	87.6	86.6	85.7	84.8	84.0	83.2	82.5	81.9			
		1:55	IAS Kts.	269	269	269	270	270	270	270	270			
-30	-53	(205)	FF/Eng. #/Hr.	1,500	1,460	1,430	1,390	1,370	1,340	1,310	1,290			
		1:40	TAS Kts.	331	331	331	331	331	331	331	331			
		(135)	% RPM	87.7	86.6	85.6	84.6	83.9	83.1	82.4	81.8			
		1:56	IAS Kts.	269	269	269	270	270	270	270	270			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LES
Vno 275 KTS EA
ALT 19,000 F

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-3	(175) 2:07 (105) 2:06	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,180 297 88.5 215	1,180 308 88.5 224	1,180 316 88.5 230	1,180 323 88.5 236	1,190 328 88.5 239	1,190 333 88.5 244	1,190 337 88.5 248	1,190 341 88.5 251
+15	-8	(185) 2:03 (105) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,220 300 88.5 219	1,230 311 88.5 229	1,230 319 88.5 235	1,230 326 88.5 241	1,230 331 88.5 245	1,240 336 88.5 248	1,240 340 88.5 252	1,240 344 88.5 256	1,240 347 88.5 [illegible]
+10	-13	(185) 1:58 (105) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,270 313 88.5 232	1,280 322 88.5 240	1,280 329 88.5 245	1,290 334 88.5 249	1,290 339 88.5 253	1,290 344 88.5 257	1,290 347 88.5 260	1,290 350 88.5 262	1,290 353 88.5 265
+5	-18	(195) 1:53 (105) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,330 316 88.5 236	1,330 325 88.5 244	1,340 332 88.5 251	1,340 338 88.5 255	1,340 342 88.5 258	1,340 346 88.5 261	1,340 350 88.5 265	1,350 353 88.5 268	1,350 356 88.5 270	[illegible] [illegible] 88.5 273
Std.	-23	(205) 1:49 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,380 319 88.5 241	1,390 328 88.5 249	1,390 335 88.5 254	1,390 340 88.5 259	1,400 345 88.5 263	1,400 349 88.5 266	1,400 353 88.5 270	1,410 356 88.5 273	1,410 359 88.5 276	1,410 362 88.5 278	1,410 364 [illegible] 279
-5	-28	(118) 1:42 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 331 88.5 254	1,450 338 88.5 260	1,460 343 88.5 264	1,460 348 88.5 269	1,460 352 88.5 272	1,470 356 88.5 275	1,470 359 88.5 278	1,470 362 88.5 280	1,470 365 88.5 284	1,470 365 87.5 285	1,450 366 86.7 285
-10	-33	(153) 1:37 (105) 1:45	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 341 88.5 265	1,540 347 88.5 270	1,540 351 88.5 273	1,550 356 88.5 278	1,550 359 88.5 281	1,550 362 88.5 283	1,520 363 87.8 284	1,500 363 87.2 284	1,470 363 86.6 285	1,450 363 86.1 285	1,430 363 85.6 285
-15	-38	(165) 1:37 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 341 88.5 268	1,540 347 88.5 273	1,540 351 88.5 276	1,550 356 88.5 281	1,550 359 88.5 284	1,530 359 88.0 284	1,500 359 87.2 284	1,480 359 86.4 284	1,460 359 85.9 285	1,440 359 85.3 285	1,420 359 [illegible] 285
-20	-43	(172) 1:37 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 340 88.5 270	1,530 345 88.5 275	1,540 350 88.5 279	1,540 354 88.5 283	1,540 355 88.4 284	1,520 355 87.5 284	1,490 355 86.7 284	1,460 355 86.0 284	1,440 355 85.4 285	1,420 355 84.8 285	1,400 355 84.4 285
-25	-48	(176) 1:37 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 338 88.5 272	1,530 343 88.5 276	1,540 348 88.5 281	1,560 351 88.5 284	1,530 351 87.8 284	1,500 351 87.0 284	1,480 351 86.3 284	1,450 351 85.7 284	1,430 351 85.1 285	1,410 351 84.6 285	1,390 351 84.2 285
-30	-53	(176) 1:37 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,530 335 88.5 272	1,530 340 88.5 276	1,540 344 88.5 280	1,550 348 88.5 284	1,520 348 87.8 284	1,490 348 87.0 284	1,470 348 86.2 284	1,440 348 85.6 284	1,420 348 85.0 285	1,400 348 84.5 285	1,380 348 84.0 285

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 1[illegible]5,000 LB
Vmo 250 KTS EAS
ALT 20,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+20	-5	(165)	FF/Eng. #/Hr.					1,150	1,150	1,150				
		2:10	TAS Kts.					305	315	322				
		(145)	% RPM					88.5	88.5	88.5				
		2:10	IAS Kts.					218	225	231				
+15	-10	(175)	FF/Eng. #/Hr.				1,190	1,200	1,200	1,200				
		2:06	TAS Kts.				307	317	325	331				
		(145)	% RPM				88.5	88.5	88.5	88.5				
		2:05	IAS Kts.				222	230	236	240				
+10	-15	(185)	FF/Eng. #/Hr.			1,240	1,240	1,250	1,250	1,250				
		2:01	TAS Kts.			310	320	327	334	339				
		(145)	% RPM			88.5	88.5	88.5	88.5	88.5				
		2:00	IAS Kts.			225	234	239	245	249				
+5	-20	(146)	FF/Eng. #/Hr.		1,290	1,290	1,300	1,300	1,300	1,300				
		1:55	TAS Kts.		312	322	330	336	342	346				
		(145)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5				
		1:56	IAS Kts.		229	237	244	249	254	257				
Std.	-25	(168)	FF/Eng. #/Hr.	1,340	1,350	1,350	1,350	1,350	1,320	1,290				
		1:51	TAS Kts.	315	325	332	338	342	342	342				
		(145)	% RPM	88.5	88.5	88.5	88.5	88.0	85.7	84.6				
		1:56	IAS Kts.	234	242	248	253	257	257	257				
-5	-30	(190)	FF/Eng. #/Hr.	1,400	1,410	1,400	1,370	1,330	1,300	1,280				
		1:46	TAS Kts.	328	336	339	339	339	339	339				
		(145)	% RPM	88.5	88.5	88.5	86.6	85.1	84.1	83.2				
		1:57	IAS Kts.	247	254	256	257	257	257	257				
-10	-35	(205)	FF/Eng. #/Hr.	1,460	1,420	1,380	1,350	1,320	1,290	1,260				
		1:43	TAS Kts.	335	335	335	335	335	335	335				
		(145)	% RPM	88.5	87.3	86.2	85.2	84.3	83.5	82.7				
		1:59	IAS Kts.	256	256	256	257	257	257	257				
-15	-40	(205)	FF/Eng. #/Hr.	1,450	1,410	1,370	1,340	1,300	1,270	1,250				
		1:44	TAS Kts.	332	332	332	332	332	332	332				
		(145)	% RPM	87.4	86.2	85.2	84.3	83.4	82.6	81.9				
		2:00	IAS Kts.	256	256	256	257	257	257	257				
-20	-45	(205)	FF/Eng. #/Hr.	1,430	1,390	1,350	1,320	1,290	1,260	1,230				
		1:45	TAS Kts.	328	328	328	328	328	328	328				
		(145)	% RPM	86.9	85.7	84.6	83.6	82.8	82.0	81.2				
		2:02	IAS Kts.	256	256	256	257	257	257	257				
-25	-50	(205)	FF/Eng. #/Hr.	1,410	1,370	1,340	1,310	1,280	1,250	1,220				
		1:46	TAS Kts.	325	325	325	325	325	325	325				
		(145)	% RPM	86.5	85.3	84.2	83.2	82.4	81.6	80.9				
		2:03	IAS Kts.	256	256	256	257	257	257	257				
-30	-55	(205)	FF/Eng. #/Hr.	1,400	1,360	1,320	1,290	1,260	1,230	1,210				
		1:47	TAS Kts.	321	321	321	321	321	321	321				
		(145)	% RPM	86.3	85.1	84.0	83.1	82.3	81.5	80.7				
		2:04	IAS Kts.	256	256	256	257	257	257	257				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 20,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+20	-5	(165)	FF/Eng. #/Hr.					1,150	1,150	1,150	1,150			
		2:10	TAS Kts.					305	315	322	328			
		(135)	% RPM					88.5	88.5	88.5	88.5			
		2:10	IAS Kts.					218	225	231	235			
+15	-10	(175)	FF/Eng. #/Hr.				1,190	1,200	1,200	1,200	1,200			
		2:06	TAS Kts.				307	317	325	331	336			
		(135)	% RPM				88.5	88.5	88.5	88.5	88.5			
		2:05	IAS Kts.				222	230	236	241	244			
+10	-15	(185)	FF/Eng. #/Hr.			1,240	1,240	1,250	1,250	1,250	1,260			
		2:01	TAS Kts.			310	320	327	334	339	343			
		(135)	% RPM			88.5	88.5	88.5	88.5	88.5	88.5			
		1:59	IAS Kts.			225	234	239	245	249	252			
+5	-20	(195)	FF/Eng. #/Hr.		1,290	1,290	1,300	1,300	1,300	1,310	1,310			
		1:54	TAS Kts.		312	322	330	336	342	346	350			
		(135)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5	88.5			
		1:56	IAS Kts.		229	237	244	249	254	257	260			
Std.	-25	(205)	FF/Eng. #/Hr.	1,340	1,350	1,350	1,350	1,360	1,360	1,360	1,360			
		1:52	TAS Kts.	315	325	332	338	344	348	353	356			
		(135)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5			
		1:50	IAS Kts.	234	242	248	253	258	261	265	268			
-5	-30	(155)	FF/Eng. #/Hr.	1,400	1,410	1,410	1,420	1,420	1,420	1,400	1,370			
		1:46	TAS Kts.	328	336	341	347	351	355	355	355			
		(135)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	87.4	85.9			
		1:50	IAS Kts.	247	254	258	264	267	270	270	270			
-10	-35	(182)	FF/Eng. #/Hr.	1,490	1,500	1,500	1,460	1,430	1,410	1,380	1,360			
		1:40	TAS Kts.	339	345	350	351	351	351	351	351			
		(135)	% RPM	88.5	88.5	88.5	88.0	87.1	86.3	85.5	84.9			
		1:50	IAS Kts.	259	264	268	270	270	270	270	270			
-15	-40	(189)	FF/Eng. #/Hr.	1,490	1,500	1,480	1,450	1,420	1,390	1,370	1,340			
		1:40	TAS Kts.	339	345	348	348	348	348	348	348			
		(135)	% RPM	88.5	88.5	88.0	87.0	86.1	85.3	84.6	84.0			
		1:52	IAS Kts.	262	267	269	270	270	270	270	270			
-20	-45	(195)	FF/Eng. #/Hr.	1,490	1,500	1,470	1,440	1,410	1,380	1,350	1,330			
		1:40	TAS Kts.	338	344	344	344	344	344	344	344			
		(135)	% RPM	88.5	88.5	87.5	86.5	85.6	84.8	84.0	83.4			
		1:53	IAS Kts.	264	269	269	270	270	270	270	270			
-25	-50	(198)	FF/Eng. #/Hr.	1,490	1,490	1,460	1,420	1,390	1,360	1,340	1,310			
		1:40	TAS Kts.	336	340	340	340	340	340	340	340			
		(135)	% RPM	88.5	88.2	87.2	86.2	85.2	84.4	83.7	83.1			
		1:54	IAS Kts.	266	269	269	270	270	270	270	270			
-30	-55	(198)	FF/Eng. #/Hr.	1,490	1,480	1,450	1,410	1,380	1,350	1,330	1,300			
		1:40	TAS Kts.	333	336	336	336	336	336	336	336			
		(135)	% RPM	88.5	88.0	86.9	85.9	85.0	84.3	83.6	82.9			
		1:55	IAS Kts.	266	269	269	270	270	270	270	270			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Vno 275 KTS EAS
ALT 20,000 FT

DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#)	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-5	(165) 2:10 (105) 2:09	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,150 305 88.5 218	1,150 315 88.5 225	1,150 322 88.5 231	1,150 328 88.5 235	1,160 333 88.5 240	1,160 338 88.5 244	1,160 342 88.5 248
+15	-10	(175) 2:06 (105) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,190 307 88.5 222	1,200 317 88.5 230	1,200 325 88.5 236	1,200 331 88.5 240	1,200 336 88.5 244	1,210 340 88.5 248	1,210 344 88.5 251	1,210 348 88.5 255
+10	-15	(185) 2:01 (105) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 310 88.5 225	1,240 320 88.5 234	1,250 327 88.5 239	1,250 334 88.5 245	1,250 339 88.5 249	1,260 343 88.5 252	1,260 347 88.5 256	1,260 351 88.5 259	1,260 354 88.5 262
+5	-20	(195) 1:56 (105) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,290 312 88.5 229	1,290 322 88.5 237	1,300 330 88.5 244	1,300 336 88.5 249	1,300 342 88.5 254	1,310 346 88.5 257	1,310 350 88.5 260	1,310 354 88.5 265	1,310 357 88.5 267	1,310 359 88.5 268
STD.	-25	(205) 1:52 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,340 315 88.5 234	1,350 325 88.5 242	1,350 332 88.5 248	1,350 338 88.5 253	1,360 344 88.5 258	1,360 348 88.5 261	1,360 353 88.5 265	1,360 356 88.5 268	1,370 359 88.5 271	1,370 262 88.5 274	1,370 364 88.5 275
-5	-30	(205) 1:47 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 328 88.5 247	1,410 336 88.5 254	1,410 341 88.5 258	1,420 347 88.5 264	1,420 351 88.5 267	1,420 355 88.5 270	1,430 359 88.5 273	1,430 362 88.5 276	1,430 365 88.5 279	1,430 367 88.5 281	1,430 370 88.5 283
-10	-35	(130) 1:37 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 339 88.5 259	1,500 345 88.5 264	1,500 350 88.5 268	1,510 355 88.5 273	1,510 358 88.5 276	1,510 362 88.5 279	1,520 365 88.5 281	1,520 368 88.5 284	1,490 369 87.7 285	1,470 369 87.1 285	1,450 369 86.5 285
-15	-40	(145) 1:39 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 339 88.5 262	1,500 345 88.5 267	1,500 350 88.5 271	1,510 355 88.5 276	1,510 358 88.5 279	1,510 362 88.5 282	1,520 365 88.5 284	1,500 365 87.9 284	1,470 365 87.2 285	1,460 365 86.6 285	1,440 365 86.1 285
-20	-45	(154) 1:39 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 338 88.5 264	1,500 344 88.5 269	1,500 349 88.5 273	1,510 353 88.5 277	1,510 357 88.5 281	1,510 361 88.5 284	1,510 361 88.2 284	1,480 361 87.5 284	1,460 361 86.9 285	1,440 361 86.2 285	1,420 361 85.7 285
-25	-50	(159) 1:39 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 336 88.5 266	1,500 342 88.5 271	1,500 347 88.5 275	1,510 351 88.5 279	1,510 355 88.5 283	1,530 357 88.3 284	1,500 357 88.0 284	1,470 357 87.3 284	1,450 357 86.7 285	1,430 357 86.2 285	1,410 357 85.6 285
-30	-55	(155) 1:39 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,490 333 88.5 266	1,500 338 88.5 270	1,500 343 88.5 274	1,510 347 88.5 279	1,510 350 88.5 281	1,510 353 88.5 284	1,490 353 87.8 284	1,470 353 87.0 284	1,440 353 86.4 285	1,420 353 85.8 285	1,400 353 85.2 285

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 21,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#)	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-7	(168) 2:15 (145) 2:14	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,110 303 88.5 213	1,120 313 88.5 220	1,120 321 88.5 226				
+15	-12	(176) 2:10 (145) 2:08	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,160 304 88.5 216	1,160 315 88.5 224	1,170 323 88.5 230	1,170 330 88.5 235				
+10	-17	(183) 2:05 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,200 305 88.5 218	1,210 316 88.5 227	1,210 325 88.5 234	1,220 332 88.5 239	1,220 338 88.5 244				
+5	-22	(191) 1:59 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 320 88.5 232	1,260 328 88.5 239	1,270 335 88.5 244	1,270 341 88.5 249	1,280 346 88.5 253				
Std.	-27	(153) 1:53 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,310 320 88.5 234	1,310 329 88.5 241	1,320 337 88.5 249	1,320 342 88.5 253	1,330 348 88.5 257	1,300 348 86.1 257				
-5	-32	(176) 1:49 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,370 323 88.5 240	1,370 333 88.5 248	1,380 340 88.5 253	1,380 345 88.5 257	1,340 345 86.9 257	1,310 345 85.3 257	1,290 345 84.4 257				
-10	-37	(197) 1:44 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 336 88.5 253	1,440 341 88.5 256	1,400 341 87.5 256	1,360 341 86.5 257	1,330 341 85.5 257	1,300 341 84.7 257	1,270 341 83.8 257				
-15	-42	(203) 1:44 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 336 88.5 255	1,420 337 87.6 256	1,380 337 86.5 256	1,350 337 85.6 257	1,320 337 84.7 257	1,280 337 83.8 257	1,260 337 83.0 257				
-20	-47	(205) 1:44 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 334 88.3 256	1,410 334 87.0 256	1,370 334 86.0 256	1,330 334 84.9 257	1,300 334 84.0 257	1,270 334 83.2 257	1,240 334 82.4 257				
-25	-52	(205) 1:44 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,440 330 88.0 256	1,390 330 86.8 256	1,360 330 85.7 256	1,320 330 84.7 257	1,290 330 83.7 257	1,260 330 82.9 257	1,230 330 82.1 257				
-30	-57	(205) 1:46 (145) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,420 326 87.6 256	1,380 326 86.5 256	1,340 326 85.4 256	1,310 326 84.5 257	1,280 326 83.6 257	1,250 326 82.7 257	1,220 326 81.9 257				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 264 KTS EAS
ALT 21,000 FT

°C DEV. FROM I.S.A. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-7	(168) 2:15 (135) 2:14	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,110 303 88.5 213	1,120 313 88.5 220	1,120 321 88.5 226	1,120 327 88.5 231			
+15	-12	(176) 2:10 (135) 2:08	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,160 304 88.5 216	1,160 315 88.5 224	1,170 323 88.5 230	1,170 330 88.5 235	1,170 335 88.5 239			
+10	-17	(183) 2:05 (135) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,200 305 88.5 218	1,210 316 88.5 227	1,210 325 88.5 234	1,220 332 88.5 239	1,220 338 88.5 244	1,230 343 88.5 248			
+5	-22	(191) 1:59 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 320 88.5 232	1,260 328 88.5 239	1,270 335 88.5 244	1,270 341 88.5 249	1,280 346 88.5 253	1,280 350 88.5 256			
Std.	-27	(195) 1:55 (135) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,310 320 88.5 234	1,310 329 88.5 241	1,320 337 88.5 249	1,320 342 88.5 253	1,330 348 88.5 257	1,330 352 88.5 261	1,330 356 88.5 264			
-5	-32	(136) 1:48 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,370 323 88.5 240	1,370 333 88.5 248	1,380 340 88.5 253	1,380 345 88.5 258	1,380 350 88.5 262	1,390 355 88.5 266	1,390 358 88.5 268	1,380 361 88.5 270			
-10	-37	(165) 1:42 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 336 88.5 253	1,450 343 88.5 258	1,460 348 88.5 262	1,470 353 88.5 267	1,470 357 88.5 270	1,420 357 87.5 270	1,400 357 86.8 270	1,370 357 86.0 270			
-15	-42	(174) 1:42 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 336 88.5 255	1,450 343 88.5 261	1,460 348 88.5 265	1,470 353 88.5 270	1,440 354 87.6 270	1,410 354 86.7 270	1,380 354 85.9 270	1,350 354 85.2 270			
-20	-47	(180) 1:43 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 335 88.5 257	1,450 341 88.5 262	1,460 347 88.5 267	1,460 350 88.1 270	1,430 350 87.2 270	1,400 350 86.3 270	1,370 350 85.5 270	1,340 350 84.8 270			
-25	-52	(184) 1:43 (135) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 333 88.5 259	1,450 339 88.5 264	1,460 345 88.5 269	1,450 346 87.7 270	1,410 346 86.8 270	1,380 346 85.9 270	1,360 346 85.1 270	1,330 346 84.4 270			
-30	-57	(184) 1:43 (135) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 330 88.5 259	1,450 337 88.5 264	1,460 341 88.5 268	1,440 342 87.4 270	1,400 342 86.5 270	1,370 342 85.7 270	1,350 342 84.9 270	1,320 342 84.2 270			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LES
Vno 275 KTS OR Mno .6
ALT 21,000 F

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-7	(168) 2:15 (105) 2:13	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,110 303 88.5 213	1,120 313 88.5 220	1,120 321 88.5 226	1,120 327 88.5 231	1,130 333 88.5 236	1,130 338 88.5 240	1,130 342 88.5 243
+15	-12	(176) 2:10 (105) 2:07	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,160 304 88.5 216	1,160 315 88.5 224	1,170 323 88.5 230	1,170 330 88.5 235	1,170 335 88.5 239	1,180 340 88.5 244	1,180 345 88.5 248	1,180 349 88.5 252
+10	-17	(183) 2:05 (105) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,200 305 88.5 218	1,210 316 88.5 227	1,210 325 88.5 234	1,220 332 88.5 239	1,220 338 88.5 244	1,230 343 88.5 248	1,230 347 88.5 252	1,230 351 88.5 255	1,230 354 88.5 257
+5	-22	(191) 1:59 (105) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 320 88.5 232	1,260 328 88.5 239	1,270 335 88.5 244	1,270 341 88.5 249	1,280 346 88.5 253	1,280 350 88.5 256	1,280 354 88.5 259	1,280 357 88.5 262	1,290 360 88.5 264
Std.	-27	(195) 1:55 (105) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,310 320 88.5 234	1,310 329 88.5 241	1,320 337 88.5 249	1,320 342 88.5 253	1,330 348 88.5 257	1,330 352 88.5 261	1,330 356 88.5 264	1,330 360 88.5 268	1,330 363 88.5 270	1,330 365 88.5 272
-5	-32	(205) 1:50 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,370 323 88.5 240	1,370 333 88.5 248	1,380 340 88.5 253	1,380 345 88.5 258	1,380 350 88.5 262	1,390 355 88.5 266	1,390 358 88.5 268	1,390 362 88.5 271	1,390 365 88.5 275	1,400 368 88.5 277	1,400 370 88.5 279
-10	-37	(120) 1:41 (105) 1:44	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 336 88.5 253	1,450 343 88.5 258	1,460 348 88.5 262	1,470 353 88.5 267	1,470 357 88.5 27[illegible]	1,470 361 88.5 274	1,480 365 88.5 277	1,480 368 88.5 279	1,480 370 88.5 282	1,450 371 87.4 282	1,430 371 86.9 282
-15	-42	(136) 1:41 (105) 1:46	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 336 88.5 255	1,450 343 88.5 261	1,460 348 88.5 265	1,470 353 88.5 270	1,470 357 88.5 273	1,470 361 88.5 277	1,480 365 88.5 280	1,480 367 88.4 281	1,450 367 87.7 282	1,430 367 87.1 282	1,410 367 86.5 282
-20	-47	(145) 1:41 (105) 1:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 335 88.5 257	1,450 341 88.5 262	1,460 347 88.5 267	1,470 352 88.5 272	1,470 356 88.5 275	1,470 360 88.5 279	1,480 363 88.5 281	1,470 363 88.1 281	1,440 363 87.4 282	1,420 363 86.7 282	1,400 363 86.1 282
-25	-52	(150) 1:41 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 333 88.5 259	1,450 339 88.5 264	1,460 345 88.5 269	1,470 350 88.5 274	1,470 354 88.5 277	1,470 358 88.5 281	1,480 359 88.5 281	1,460 359 87.8 281	1,430 359 87.0 282	1,410 359 86.4 282	1,390 359 85.8 282
-30	-57	(149) 1:41 (105) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,450 330 88.5 258	1,450 336 88.5 264	1,460 341 88.5 268	1,470 346 88.5 273	1,470 350 88.5 276	1,470 354 88.5 280	1,470 355 88.5 281	1,440 355 87.7 281	1,420 355 86.9 282	1,400 355 86.2 282	1,370 355 85.5 282

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 22,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#)	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-9	(155) 2:19 (145) 2:18	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,080 309 88.5 213	1,090 318 88.5 220				
+15	-14	(165) 2:13 (145) 2:12	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,130 311 88.5 217	1,130 321 88.5 225	1,140 328 88.5 230				
+10	-19	(175) 2:08 (145) 2:06	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,170 315 88.5 222	1,180 324 88.5 229	1,180 331 88.5 235	1,190 337 88.5 239				
+5	-24	(185) 2:03 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,220 316 88.5 224	1,230 325 88.5 233	1,230 333 88.5 239	1,230 339 88.5 243	1,240 344 88.5 247				
Std.	-29	(185) 1:57 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,280 326 88.5 235	1,280 334 88.5 242	1,290 341 88.5 248	1,290 346 88.5 252	1,290 351 88.5 256				
-5	-34	(160) 1:51 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,340 329 88.5 240	1,340 337 88.5 246	1,350 343 88.5 252	1,350 349 88.5 257	1,330 351 87.8 258	1,300 351 85.7 258				
-10	-39	(182) 1:46 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 244	1,410 339 88.5 251	1,420 346 88.5 256	1,380 347 87.6 258	1,350 347 86.7 258	1,310 347 85.7 258	1,280 347 84.9 258				
-15	-44	(188) 1:47 (145) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 247	1,410 339 88.5 253	1,400 343 87.9 257	1,360 343 86.9 258	1,330 343 85.9 258	1,300 343 85.0 258	1,270 343 84.2 258				
-20	-49	(194) 1:46 (145) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 250	1,410 339 88.5 256	1,390 340 87.5 257	1,350 340 86.4 258	1,320 340 85.4 258	1,290 340 84.5 258	1,260 340 83.7 258				
-25	-54	(197) 1:46 (145) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 329 88.5 251	1,410 336 88.4 257	1,370 336 87.2 257	1,340 336 86.1 258	1,310 336 85.1 258	1,280 336 84.2 258	1,250 336 83.4 258				
-30	-57	(196) 1:46 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 327 88.5 252	1,410 333 88.2 257	1,370 333 87.0 257	1,330 333 86.0 258	1,300 333 85.0 258	1,260 333 84.1 258	1,240 333 83.2 258				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB
Vno 262 KTS EAS
ALT 22,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-9	(155) 2:19 (135) 2:18	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,080 309 88.5 213	1,090 318 88.5 220	1,090 326 88.5 226			
+15	-14	(165) 2:13 (135) 2:12	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,130 311 88.5 217	1,130 321 88.5 225	1,140 328 88.5 230	1,140 335 88.5 235			
+10	-19	(175) 2:08 (135) 2:06	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,170 315 88.5 222	1,180 324 88.5 229	1,180 331 88.5 235	1,190 337 88.5 239	1,190 342 88.5 243			
+5	-24	(185) 2:03 (135) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,220 316 88.5 224	1,230 325 88.5 233	1,230 333 88.5 239	1,230 339 88.5 243	1,240 344 88.5 247	1,240 349 88.5 251			
Std.	-29	(185) 1:57 (135) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,280 326 88.5 235	1,280 334 88.5 242	1,290 341 88.5 248	1,290 346 88.5 252	1,290 351 88.5 256	1,300 356 88.5 259			
-5	-34	(195) 1:52 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,340 329 88.5 240	1,340 337 88.5 246	1,350 343 88.5 252	1,350 349 88.5 257	1,350 353 88.5 260	1,350 358 88.5 264	1,360 361 88.5 266			
-10	-39	(145) 1:44 (135) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 244	1,410 339 88.5 251	1,420 346 88.5 256	1,420 351 88.5 261	1,430 356 88.5 265	1,430 360 88.5 268	1,440 364 87.9 271	1,390 364 87.0 271			
-15	-44	(155) 1:45 (135) 1:49	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 247	1,410 339 88.5 253	1,420 346 88.5 259	1,420 351 88.5 264	1,430 356 88.5 268	1,430 360 88.4 271	1,400 360 87.4 271	1,380 360 86.6 271			
-20	-49	(163) 1:45 (135) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 250	1,410 339 88.5 256	1,420 345 88.5 261	1,420 351 88.5 267	1,430 355 88.5 270	1,420 356 88.0 271	1,390 356 87.1 271	1,360 356 86.3 271			
-25	-54	(167) 1:45 (135) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 329 88.5 251	1,410 337 88.5 258	1,420 343 88.5 263	1,420 348 88.5 268	1,440 352 88.5 271	1,410 352 87.8 271	1,380 352 86.8 271	1,350 352 86.0 271			
-30	-57	(164) 1:45 (135) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 327 88.5 252	1,410 334 88.5 257	1,420 340 88.5 262	1,420 345 88.5 267	1,430 349 88.5 271	1,400 350 87.4 271	1,370 350 86.6 271	1,340 350 85.7 271			

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 135,000 LB & LESS
Mno .62
ALT 22,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-9	(155) 2:19 (105) 2:16	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,080 309 88.5 213	1,090 318 88.5 220	1,090 326 88.5 226	1,090 332 88.5 232	1.090 337 88.5 236	1,100 342 88.5 239
+15	-14	(165) 2:13 (105) 2:12	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,130 311 88.5 217	1,130 321 88.5 225	1,140 328 88.5 230	1,140 335 88.5 235	1,140 340 88.5 240	1,140 344 88.5 243	1,140 348 88.5 246
+10	-19	(175) 2:08 (105) 2:06	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,170 315 88.5 222	1,180 324 88.5 229	1,180 331 88.5 235	1,190 337 88.5 239	1,190 342 88.5 243	1,190 347 88.5 248	1,190 351 88.5 251	1,190 354 88.5 253
+5	-24	(185) 2:03 (105) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,220 316 88.5 224	1,230 325 88.5 233	1,230 333 88.5 239	1,230 339 88.5 243	1,240 344 88.5 247	1,240 349 88.5 251	1,240 353 88.5 255	1,250 357 88.5 258	1,250 360 88.5 260
Std.	-29	(185) 1:57 (105) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,280 326 88.5 235	1,280 334 88.5 242	1,290 341 88.5 248	1,290 346 88.5 252	1,290 351 88.5 256	1,300 356 88.5 259	1,300 360 88.5 263	1,300 363 88.5 266	1,300 365 88.5 267
-5	-34	(195) 1:52 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,340 329 88.5 240	1,340 337 88.5 246	1,350 343 88.5 252	1,350 349 88.5 257	1,350 353 88.5 260	1,350 358 88.5 264	1,360 361 88.5 266	1,360 365 88.5 270	1,360 368 88.5 273	1,360 370 88.5 274
-10	-39	(125) 1:44 (105) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 244	1,410 339 88.5 250	1,420 346 88.5 256	1,420 351 88.5 261	1,430 356 88.5 265	1,430 360 88.5 268	1,440 364 88.5 271	1,440 367 88.5 274	1,420 370 87.7 277	1,400 370 87.1 277	1,370 370 86.6 277
-15	-44	(138) 1:44 (105) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 247	1,410 339 88.5 253	1,420 346 88.5 259	1,420 351 88.5 264	1,430 356 88.5 268	1,430 360 88.5 271	1,440 364 88.5 275	1,430 366 88.1 276	1,400 366 87.4 277	1,380 366 86.7 277	1,360 366 86.1 277
-20	-49	(148) 1:44 (105) 1:51	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 331 88.5 250	1,410 339 88.5 256	1,420 345 88.5 261	1,420 351 88.5 267	1,430 355 88.5 270	1,430 359 88.5 273	1,450 362 88.5 276	1,420 362 87.9 276	1,390 362 87.1 277	1,370 362 86.4 277	1,350 362 85.7 277
-25	-54	(152) 1:41 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 329 88.5 251	1,410 337 88.5 258	1,420 343 88.5 263	1,420 348 88.5 268	1,430 353 88.5 272	1,430 357 88.5 275	1,440 358 88.5 276	1,410 358 87.7 276	1,390 358 86.9 277	1,360 358 86.2 277	1,340 358 85.5 277
-30	-57	(149) 1:44 (105) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,400 327 88.5 252	1,410 334 88.5 257	1,420 340 88.5 262	1,420 345 88.5 267	1,430 349 88.5 271	1,430 353 88.5 274	1,430 355 88.4 276	1,400 355 87.5 276	1,380 355 86.6 277	1,350 355 85.9 277	1,330 355 85.3 277

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 23,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
+20	-11	(158)	FF/Eng. #/Hr.						1,060	1,060				
		2:21	TAS Kts.						307	318				
		(145)	% RPM						88.5	88.5				
		2:21	IAS Kts.						208	216				
+15	-16	(166)	FF/Eng. #/Hr.					1,100	1,100	1,110				
		2:16	TAS Kts.					308	319	327				
		(145)	% RPM					88.5	88.5	88.5				
		2:15	IAS Kts.					211	220	225				
+10	-21	(174)	FF/Eng. #/Hr.				1,140	1,150	1,150	1,160				
		2:11	TAS Kts.				310	321	330	337				
		(145)	% RPM				88.5	88.5	88.5	88.5				
		2:09	IAS Kts.				215	223	230	235				
+5	-26	(182)	FF/Eng. #/Hr.			1,190	1,200	1,200	1,200	1,210				
		2:06	TAS Kts.			312	322	331	338	345				
		(145)	% RPM			88.5	88.5	88.5	88.5	88.5				
		2:04	IAS Kts.			217	226	233	238	244				
Std.	-31	(185)	FF/Eng. #/Hr.			1,240	1,250	1,250	1,250	1,260				
		2:01	TAS Kts.			322	331	339	345	351				
		(145)	% RPM			88.5	88.5	88.5	88.5	88.5				
		1:59	IAS Kts.			228	236	242	247	251				
-5	-36	(195)	FF/Eng. #/Hr.		1,290	1,300	1,310	1,310	1,310	1,320				
		1:57	TAS Kts.		324	333	341	347	352	357				
		(145)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5				
		1:54	IAS Kts.		232	239	246	251	255	258				
-10	-41	(169)	FF/Eng. #/Hr.		1,370	1,370	1,380	1,360	1,330	1,300				
		1:49	TAS Kts.		336	343	350	353	353	353				
		(145)	% RPM		88.5	88.5	88.5	88.3	87.3	86.4				
		1:56	IAS Kts.		244	250	256	258	258	258				
-15	-46	(176)	FF/Eng. #/Hr.	1,360	1,370	1,370	1,380	1,350	1,310	1,280				
		1:49	TAS Kts.	327	336	343	349	349	349	349				
		(145)	% RPM	88.5	88.5	88.5	88.5	87.4	86.4	85.4				
		1:57	IAS Kts.	240	247	252	258	258	258	258				
-20	-51	(180)	FF/Eng. #/Hr.	1,360	1,370	1,370	1.370	1,340	1,300	1,270				
		1:49	TAS Kts.	326	335	342	345	345	345	345				
		(145)	% RPM	88.5	88.5	88.5	88.0	86.9	85.9	85.0				
		1:58	IAS Kts.	242	249	254	258	258	258	258				
-25	-56	(184)	FF/Eng. #/Hr.	1,360	1,370	1,370	1,360	1,320	1,290	1,260				
		1:49	TAS Kts.	325	334	341	341	341	341	341				
		(145)	% RPM	88.5	88.5	88.5	87.7	86.6	85.7	84.8				
		1:59	IAS Kts.	244	251	257	258	258	258	258				
-30	-57	(181)	FF/Eng. #/Hr.	1,360	1,370	1,370	1,360	1,320	1,290	1,260				
		1:49	TAS Kts.	324	331	338	340	340	340	340				
		(145)	% RPM	88.5	88.5	88.5	87.9	86.8	85.6	84.7				
		1:59	IAS Kts.	244	250	255	258	258	258	258				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB & LESS
Mno .62
ALT 23,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-11	(158) 2:21 (105) 2:20	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,060 307 88.5 208	1,060 318 88.5 216	1,060 326 88.5 222	1,070 333 88.5 228	1,070 338 88.5 232	1,070 343 88.5 235
+15	-16	(166) 2:16 (105) 2:14	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,100 308 88.5 211	1,100 319 88.5 220	1,110 327 88.5 225	1,110 334 88.5 230	1,110 340 88.5 236	1,120 345 88.5 240	1,120 349 88.5 242
+10	-21	(174) 2:11 (105) 2:10	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,140 310 88.5 215.	1,150 321 88.5 223	1,150 330 88.5 230	1,160 337 88.5 235	1,160 343 88.5 240	1,160 348 88.5 244	1,160 352 88.5 247	1,160 355 88.5 249
+5	-26	(182) 2:06 (105) 2:04	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,190 312 88.5 217	1,190 322 88.5 226	1,200 331 88.5 233	1,200 338 88.5 238	1,210 345 88.5 244	1,210 350 88.5 247	1,210 354 88.5 251	1,210 358 88.5 254	1,210 361 88.5 256
Std.	-31	(185) 2:01 (105) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 322 88.5 228	1,250 331 88.5 236	1,250 339 88.5 242	1,250 345 88.5 247	1,260 351 88.5 251	1,260 355 88.5 254	1,260 359 88.5 258	1,270 363 88.5 261	1,270 366 88.5 264
-5	-36	(195) 1:56 (105) 1:53	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,290 324 88.5 232	1,300 333 88.5 239	1,310 341 88.5 246	1,310 347 88.5 251	1,310 352 88.5 255	1,320 357 88.5 258	1,320 361 88.5 262	1,330 365 88.5 266	1,330 368 88.5 268	1,330 370 88.5 270
-10	-41	(130) 1:47 (105) 1:54	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,370 336 88.5 244	1,370 343 88.5 250	1,380 350 88.5 256	1,390 355 88.5 260	1,390 359 88.5 263	1,400 363 88.5 266	1,400 367 88.5 269	1,360 368 87.3 271	1,340 368 86.6 271	1,320 368 86.0 271
-15	-46	(142) 1:47 (105) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 327 88.5 240	1,370 336 88.5 247	1,370 343 88.5 252	1,380 350 88.5 259	1,390 355 88.5 263	1,390 359 88.5 266	1,400 363 88.5 269	1,380 364 87.9 270	1,350 364 87.1 271	1,330 364 86.4 271	1,310 364 85.6 271
-20	-51	(150) 1:48 (105) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 326 88.5 242	1,370 335 88.5 249	1,370 342 88.5 254	1,380 349 88.5 261	1,390 354 88.5 265	1,390 358 88.5 268	1,400 360 88.5 270	1,370 360 87.6 270	1,350 360 86.8 271	1,320 360 86.0 271	1,300 360 85.4 271
-25	-56	(155) 1:48 (105) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 325 88.5 244	1,370 334 88.5 251	1,370 341 88.5 257	1,380 347 88.5 263	1,390 352 88.5 266	1,390 356 88.5 270	1,390 356 88.5 270	1,370 356 87.5 270	1,340 356 86.6 271	1,320 356 85.9 271	1,290 356 85.2 271
-30	-57	(148) 1:48 (105) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,360 324 88.5 244	1,370 331 88.5 250	1,370 338 88.5 255	1,380 344 88.5 261	1,390 349 88.5 266	1,390 353 88.5 269	1,380 355 88.2 270	1,360 355 87.2 270	1,330 355 86.4 271	1,310 355 85.6 271	1,280 355 85.0 271

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 24,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-13	(155) 2:26 (145) 2:26	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,030 301 88.5 201	1,030 314 88.5 210				
+15	-18	(155) 2:19 (145) 2:19	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,080 315 88.5 212	1,080 325 88.5 220				
+10	-23	(165) 2:15 (145) 2:14	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,110 318 88.5 217	1,120 327 88.5 223	1,120 335 88.5 230				
+5	-28	(175) 2:11 (145) 2:08	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,150 317 88.5 219	1,160 328 88.5 227	1,170 336 88.5 233	1,170 343 88.5 238				
Std.	-33	(175) 2:04 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,210 328 88.5 230	1,220 337 88.5 236	1,220 344 88.5 241	1,230 350 88.5 246				
-5	-38	(185) 1:59 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 329 88.5 232	1,270 338 88.5 240	1,270 345 88.5 245	1,280 351 88.5 250	1,280 356 88.5 253				
-10	-43	(152) 1:51 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,320 331 88.5 236	1,330 340 88.5 243	1,340 347 88.5 249	1,350 353 88.5 254	1,350 358 88.5 258	1,310 359 88.5 259				
-15	-48	(160) 1:51 (145) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,320 331 88.5 239	1,330 340 88.5 246	1,340 347 88.5 253	1,350 353 88.5 257	1,330 355 87.8 259	1,300 355 86.8 259				
-20	-53	(166) 1:52 (145) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,310 320 88.5 233	1,320 330 88.5 241	1,330 339 88.5 248	1,340 346 88.5 255	1,350 351 88.5 259	1,320 351 87.6 259	1,290 351 86.4 259				
-25	-57	(169) 1:52 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,310 320 88.5 235	1,320 330 88.5 243	1,330 338 88.5 250	1,340 345 88.5 256	1,350 348 88.5 259	1,320 348 87.3 259	1,280 348 86.2 259				
-30	-57	(165) 1:51 (145) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,310 319 88.5 234	1,320 328 88.5 242	1,330 336 88.5 248	1,340 343 88.5 255	1,350 348 88.5 259	1,310 348 87.2 259	1,280 348 86.2 259				

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 145,000 LB & LESS
Mmo .62
ALT 24,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-13	(155) 2:26 (105) 2:24	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,030 301 88.5 201	1,030 314 88.5 210	1,030 324 88.5 217	1,040 331 88.5 223	1,040 337 88.5 227	1,040 342 88.5 231
+15	-18	(155) 2:19 (105) 2:18	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,080 315 88.5 212	1,080 325 88.5 220	1,080 333 88.5 225	1,080 339 88.5 231	1,080 345 88.5 235	1,090 349 88.5 238
+10	-23	(165) 2:15 (105) 2:13	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,110 318 88.5 217	1,120 327 88.5 223	1,120 335 88.5 230	1,130 341 88.5 234	1,130 347 88.5 239	1,130 351 88.5 242	1,130 355 88.5 245
+5	-28	(175) 2:11 (105) 2:07	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,150 317 88.5 219	1,160 328 88.5 227	1,170 336 88.5 233	1,170 343 88.5 238	1,170 348 88.5 242	1,180 353 88.5 247	1,180 357 88.5 249	1,180 361 88.5 252
Std.	-33	(175) 2:04 (105) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,210 328 88.5 230	1,220 337 88.5 236	1,220 344 88.5 241	1,230 350 88.5 246	1,230 355 88.5 250	1,230 359 88.5 254	1,230 363 88.5 257	1,230 366 88.5 260
-5	-38	(185) 1:59 (105) 1:56	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,260 329 88.5 232	1,270 338 88.5 240	1,270 345 88.5 245	1,280 351 88.5 250	1,280 356 88.5 253	1,290 360 88.5 257	1,290 364 88.5 261	1,290 367 88.5 263	1,290 370 88.5 265
-10	-43	(132) 1:50 (105) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,320 331 88.5 236	1,330 340 88.5 243	1,340 347 88.5 249	1,350 353 88.5 254	1,350 358 88.5 258	1,360 362 88.5 261	1,360 366 88.5 264	1,310 367 87.0 266	1,290 367 86.3 266	1,270 367 85.6 266
-15	-48	(143) 1:51 (105) 1:59	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,320 331 88.5 239	1,330 340 88.5 246	1,340 347 88.5 253	1,350 353 88.5 257	1,350 358 88.5 261	1,360 362 88.5 264	1,330 362 87.6 265	1,300 362 86.8 266	1,280 362 86.0 266	1,260 362 85.3 266
-20	-53	(151) 1:51 (105) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,310 320 88.5 233	1,320 330 88.5 241	1,330 339 88.5 248	1,340 346 88.5 255	1,340 352 88.5 259	1,350 357 88.5 263	1,350 359 88.3 265	1,330 359 87.4 265	1,300 359 86.6 266	1,270 359 85.8 266	1,250 359 85.0 266
-25	-57	(155) 1:51 (105) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,310 320 88.5 235	1,320 330 88.5 243	1,330 338 88.5 250	1,340 345 88.5 256	1,340 350 88.5 260	1,350 355 88.5 264	1,350 355 88.2 265	1,320 355 87.4 265	1,300 355 86.5 266	1,270 355 85.6 266	1,250 355 84.9 266
-30	-57	(148) 1:55 (105) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,310 319 88.5 234	1,320 328 88.5 242	1,330 336 88.5 248	1,340 343 88.5 255	1,340 348 88.5 259	1,350 352 88.5 262	1,350 355 88.1 265	1,320 355 87.1 265	1,290 355 86.2 266	1,260 355 85.4 266	1,240 355 84.7 266

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB & LESS
Mno .62
ALT 26,000 F

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-17	(145) 2:35 (105) 2:32	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.							970 305 88.5 197	980 319 88.5 213	980 328 88.5 221	990 336 88.5 227	990 342 88.5 223
+15	-22	(145) 2:27 (105) 2:26	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.							1,020 319 88.5 208	1,020 330 88.5 216	1,030 337 88.5 222	1,030 344 88.5 227	1,030 349 88.5 230
+10	-27	(155) 2:23 (105) 2:20	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,050 318 88.5 210	1,060 329 88.5 217	1,070 338 88.5 224	1,070 345 88.5 230	1,070 350 88.5 233	1,070 355 88.5 237
+5	-32	(165) 2:18 (105) 2:14	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,090 316 88.5 210	1,100 329 88.5 220	1,100 338 88.5 226	1,110 345 88.5 231	1,110 352 88.5 238	1,110 356 88.5 241	1,120 360 88.5 243
Std.	-37	(165) 2:12 (105) 2:09	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,140 329 88.5 222	1,150 338 88.5 229	1,150 346 88.5 235	1,160 352 88.5 239	1,160 357 88.5 244	1,160 361 88.5 247	1,160 365 88.5 250
-5	-42	(112) 2:04 (105) 2:03	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,180 329 88.5 225	1,190 339 88.5 232	1,200 346 88.5 237	1,200 353 88.5 242	1,210 358 88.5 246	1,210 363 88.5 251	1,210 367 88.5 254	1,220 367 85.7 254
-10	-47	(136) 1:58 (105) 2:07	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 331 88.5 228	1,250 341 88.5 236	1,260 348 88.5 242	1,270 354 88.5 246	1,270 359 88.5 250	1,260 363 88.4 253	1,230 363 87.5 254	1,200 363 86.5 254	1,180 363 85.6 254
-15	-52	(145) 1:58 (105) 2:08	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 331 88.5 231	1,250 341 88.5 239	1,260 348 88.5 245	1,270 354 88.5 249	1,270 359 88.5 253	1,240 359 87.6 253	1,220 359 86.6 254	1,190 359 85.7 254	1,170 359 84.9 254
-20	-57	(152) 1:58 (105) 2:09	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 331 88.5 234	1,250 340 88.5 242	1,260 348 88.5 248	1,270 354 88.5 253	1,260 355 88.3 254	1,230 355 87.3 254	1,210 355 86.3 255	1,180 355 85.4 255	1,160 355 84.6 255
-25	-57	(149) 1:58 (105) 2:09	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 330 88.5 233	1,250 339 88.5 241	1,260 346 88.5 246	1,270 352 88.5 251	1,260 355 88.3 253	1,230 355 87.2 253	1,210 355 86.2 254	1,180 355 85.3 254	1,160 355 84.5 254
-30	-57	(146) 1:58 (105) 2:09	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,240 329 88.5 232	1,250 338 88.5 240	1,260 345 88.5 245	1,270 351 88.5 250	1,270 355 88.3 253	1,240 355 87.2 253	1,210 355 86.2 254	1,180 355 85.3 254	1,160 355 84.6 254

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB & LESS
Mno .62
ALT 28,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-21	(135) 2:43 (105) 2:41	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.								920 310 88.5 193	920 323 88.5 203	930 332 88.5 208	930 340 88.5 214
+15	-26	(135) 2:36 (105) 2:35	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.								960 322 88.5 203	960 333 88.5 211	970 341 88.5 217	970 347 88.5 221
+10	-31	(145) 2:32 (105) 2:29	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.							990 320 88.5 204	1,000 332 88.5 213	1,000 341 88.5 219	1,010 348 88.5 224	1,010 354 88.5 228
+5	-36	(155) 2:26 (105) 2:23	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,030 317 88.5 204	1,040 331 88.5 214	1,040 341 88.5 221	1,050 349 88.5 227	1,050 354 88.5 231	1,050 359 88.5 235
Std.	-41	(155) 2:20 (105) 2:16	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,070 331 88.5 216	1,080 341 88.5 223	1,090 349 88.5 229	1,090 355 88.5 234	1,090 360 88.5 238	1,100 364 88.5 241
-5	-46	(116) 2:12 (105) 2:15	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,120 332 88.5 220	1,120 342 88.5 227	1,130 349 88.5 232	1,140 355 88.5 237	1,140 360 88.5 241	1,140 364 86.9 244	1,110 364 85.3 244
-10	-51	(136) 2:05 (105) 2:18	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,180 341 88.5 229	1,190 349 88.5 235	1,190 355 88.5 239	1,170 360 87.7 242	1,150 36[illegible] 86.6 243	1,120 360 85.6 243	1,090 360 84.7 243
-15	-56	(143) 2:06 (105) 2:19	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,170 331 88.5 224	1,180 341 88.5 231	1,190 349 88.5 237	1,190 355 88.5 241	1,160 356 87.4 242	1,130 356 86.4 243	1,100 356 85.4 243	1,080 356 84.4 243
-20	-57	(145) 2:06 (105) 2:20	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,170 331 88.5 224	1,180 341 88.5 232	1,190 349 88.5 238	1,190 355 88.5 242	1,160 355 87.4 242	1,130 355 86.3 243	1,100 355 85.3 243	1,070 355 84.3 243
-25	-57	(144) 2:06 (105) 2:20	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,170 330 88.5 224	1,180 340 88.5 231	1,190 348 88.5 237	1,190 355 88.5 242	1,160 355 87.4 242	1,130 355 86.3 243	1,100 355 85.3 243	1,070 355 84.4 243
-30	-57	(143) 2:06 (105) 2:19	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,170 329 88.5 223	1,180 339 88.5 230	1,190 347 88.5 236	1,190 354 88.5 241	1,170 355 87.5 242	1,140 355 86.4 243	1,110 355 85.4 243	1,080 355 84.4 243

NORMAL CRUISE
FOUR ENGINES 88.5% LP RPM (1164°K)

ZFW 155,000 LB & LE
Mno .
ALT 30,000 F

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
+20	-25	(125) 2:52 (105) 2:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.									870 315 88.5 191	870 328 88.5 199	880 337 88.5 204
+15	-30	(135) 2:47 (105) 2:45	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.								900 310 88.5 188	910 327 88.5 200	910 337 88.5 206	910 345 88.5 212
+10	-35	(135) 2:40 (105) 2:38	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.								940 324 88.5 199	940 336 88.5 208	950 344 88.5 213	950 351 88.5 218
+5	-40	(145) 2:35 (105) 2:32	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.							970 320 88.5 199	970 334 88.5 208	980 344 88.5 216	980 351 88.5 220	990 358 88.5 225
Std.	-45	(145) 2:29 (105) 2:26	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.							1,010 333 88.5 210	1,020 343 88.5 217	1,020 351 88.5 223	1,030 357 88.5 227	1,030 362 88.5 231
-5	-50	(118) 2:20 (105) 2:26	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,050 331 88.5 211	1,050 342 88.5 219	1,060 351 88.5 225	1,070 357 88.5 230	1,060 361 86.4 233	1,030 361 84.9 233
-10	-55	(136) 2:14 (105) 2:27	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,100 342 88.5 221	1,110 351 88.5 228	1,110 357 88.1 232	1,080 357 86.8 233	1,050 357 85.7 233	1,020 357 84.7 233
-15	-57	(139) 2:15 (105) 2:29	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,090 330 88.5 214	1,100 342 88.5 222	1,110 351 88.5 229	1,100 355 87.9 232	1,070 355 86.7 233	1,040 355 85.6 233	1,010 355 84.6 233
-20	-57	(139) 2:15 (105) 2:30	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,090 330 88.5 214	1,100 342 88.5 222	1,110 351 88.5 229	1,100 355 87.9 232	1,060 355 86.7 233	1,030 355 85.5 233	1,000 355 84.5 233
-25	-57	(138) 2:15 (105) 2:30	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,090 329 88.5 213	1,100 342 88.5 222	1,110 351 88.5 228	1,100 355 87.9 232	1,060 355 86.7 233	1,030 355 85.5 233	1,000 355 84.5 233
-30	-57	(137) 2:14 (105) 2:29	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,090 328 88.5 212	1,100 341 88.5 221	1,110 350 88.5 227	1,100 355 87.9 232	1,070 355 86.7 233	1,040 355 85.6 233	1,010 355 84.6 233

3. Intermediate Cruise, Four Engines

The intermediate cruise performance is presented in Pages 2.60 to 2.84 for each 1,000 foot altitude between 10,000 and 24,000 feet and for each 2,000 foot altitude between 24,000 and 30,000 feet. Data are included for the ambient temperature range of ISA - 30°C to ISA + 20°C with the following exceptions: 11,000 and 13,000 feet, ISA to ISA + 20°C; 21,000 and 23,000 feet, ISA - 30°C to ISA. This variation in altitude over the temperature range is related to the practical operational altitudes as a function of power available. At lower altitudes where the limit V_{no} speed is a factor, the data are segregated by zero fuel weights, similar to the arrangement as discussed in the section related to Normal Four Engine Cruise.

In most cases, these charts call for flying at an rpm somewhat less than maximum recommended cruise. This procedure should therefore be employed only when restricted to a given altitude and it is desired to seek a compromise between minimum fuel consumption and high speed operation. Improved range would be obtained by using the maximum recommended cruise rpm at the higher altitudes attainable with this power (See Figure 1-1 and the Normal Four Engine Cruise charts).

When variation in rpm and fuel flow are indicated, the elapsed time column (at the left) identifies the related weight in thousands of pounds (in brackets).

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 10,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+15	(195) 1:41 (145) 2:08	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	247 1,480 88.5 295	253 1,480 88.5 302	249 1,410 85.1 297	246 1,350 83.4 293	241 1,290 81.8 287	236 1,230 80.1 281	229 1,170 77.9 274				
+15	+10	(194) 1:43 (145) 2:[illegible]9	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,480 85.8 299	253 1,450 84.8 299	249 1,400 83.2 295	247 1,340 81.8 291	241 1,280 79.9 285	236 1,220 78.0 279	229 1,160 75.8 271				
+10	+5	(191) 1:45 (145) 2:11	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,470 83.6 296	253 1,440 82.8 296	251 1,390 81.6 294	247 1,330 79.9 289	242 1,270 78.0 283	236 1,210 76.0 276	228 1,140 73.9 267				
+5	0	(190) 1:46 (145) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,460 81.6 293	253 1,420 80.8 293	251 1,390 79.6 292	247 1,330 77.9 287	241 1,260 76.1 280	234 1,190 74.3 272	225 1,110 72.2 262				
Std.	-5	(187) 1:48 (145) 2:19	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,440 79.6 291	253 1,410 78.8 291	252 1,370 78.0 290	247 1,310 76.3 284	241 1,240 74.4 277	232 1,170 72.6 267	221 1,080 70.4 256				
-5	-10	(186) 1:49 (145) 2:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,430 78.6 288	253 1,390 77.7 288	253 1,370 77.0 288	248 1,300 75.2 281	241 1,230 73.6 274	234 1,150 71.8 266	224 1,070 69.8 255				
-10	-15	(185) 1:51 (145) 2:21	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,410 78.9 285	253 1,380 78.0 285	253 1,350 77.5 285	248 1,280 75.8 279	241 1,210 73.9 272	233 1,140 71.8 263	223 1,060 69.2 252				
-15	-20	(185) 1:52 (145) 2:21	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,400 78.4 282	253 1,370 77.6 282	253 1,340 76.8 282	248 1,270 75.1 276	241 1,200 73.3 269	234 1,130 71.2 261	224 1,060 68.9 251				
-20	-25	(185) 1:54 (155) 2:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,380 77.9 280	253 1,350 77.[illegible] 280	253 1,320 76.3 280	248 1,260 74.6 274	241 1,190 72.7 266	233 1,120 70.6 258					
-25	-30	(185) 1:55 (155) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,370 77.6 277	253 1,340 76.7 277	253 1,310 76.0 277	248 1,250 74.2 271	240 1,180 72.3 263	233 1,110 70.1 255					
-30	-35	(185) 1:55 (155) 2:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,360 77.3 274	253 1,330 76.4 274	253 1,300 75.6 274	247 1,230 73.9 268	240 1,160 72.0 260	232 1,090 69.8 252					

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 145,000 LB & LESS
Vno 262/275 KTS EAS
ALT 10,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+15	(194) 1:43 (115) 2:43	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	247 1,480 88.5 295	253 1,480 88.5 302	249 1,410 85.1 297	246 1,350 83.4 293	241 1,290 81.8 287	236 1,230 80.1 281	229 1,170 77.9 274	223 1,100 75.4 266	214 1,020 73.0 255	202 920 70.6 241	
+15	+10	(205) 1:39 (115) 2:49	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	256 1,510 86.6 302	253 1,460 84.9 299	249 1,400 83.2 295	247 1,340 81.8 291	241 1,280 79.9 285	236 1,220 78.0 279	229 1,160 75.8 271	221 1,090 73.6 262	212 1,000 71.4 250	196 890 68.8 232	
+10	+5	(205) 1:40 (125) 2:36	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,500 84.5 302	254 1,450 82.9 298	251 1,390 81.6 294	247 1,330 79.9 289	242 1,270 78.0 283	236 1,210 76.0 276	228 1,140 73.9 267	219 1,060 72.0 257	207 960 69.6 243		
+5	0	(205) 1:40 (135) 2:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,500 82.9 300	255 1,440 81.2 296	251 1,390 79.6 292	247 1,330 77.9 287	241 1,260 76.1 280	234 1,190 74.2 272	225 1,110 72.2 262	214 1,030 70.2 250			
Std.	-5	(205) 1:41 (145) 2:19	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	260 1,490 81.0 299	257 1,440 79.6 295	252 1,370 78.0 290	247 1,310 76.3 284	241 1,240 74.4 277	232 1,170 72.6 267	221 1,080 70.4 256				
-5	-10	(205) 1:41 (145) 2:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	262 1,480 80.2 298	257 1,420 78.7 293	253 1,370 77.0 288	248 1,300 75.2 281	241 1,230 73.6 274	234 1,150 71.8 266	224 1,070 69.8 255				
-10	-15	(205) 1:42 (145) 2:21	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	262 1,470 80.5 296	258 1,410 79.0 291	252 1,350 77.5 285	248 1,280 75.8 279	241 1,210 73.9 272	233 1,140 71.8 263	223 1,060 69.2 252				
-15	-20	(205) 1:43 (145) 2:21	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	264 1,460 79.9 294	259 1,400 78.4 289	253 1,340 76.8 283	248 1,270 75.1 276	241 1,200 73.3 269	234 1,130 71.2 261	224 1,060 68.9 251				
-20	-25	(205) 1:43 (155) 2:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	263 1,450 79.4 291	258 1,390 77.9 286	252 1,320 76.3 280	248 1,260 74.6 274	241 1,190 72.7 266	233 1,120 70.6 258					
-25	-30	(205) 1:45 (155) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	263 1,430 79.0 288	259 1,370 77.5 283	253 1,310 76.0 277	248 1,250 74.2 271	240 1,180 72.3 263	233 1,110 70.1 255					
-30	-35	(205) 1:46 (155) 2:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	262 1,420 78.7 284	258 1,360 77.2 280	252 1,300 75.6 274	247 1,230 73.9 268	240 1,160 72.0 260	232 1,090 69.8 252					

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 11,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+13	(190) 1:45 (145) 2:10	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		248 1,440 88.5 301	248 1,400 86.2 301	246 1,340 84.3 296	240 1,280 82.3 290	235 1,220 80.3 284	228 1,150 78.2 276				
+15	+8	(194) 1:44 (145) 2:11	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		253 1,450 85.7 304	249 1,390 84.2 299	246 1,330 82.4 294	240 1,270 80.5 288	234 1,210 78.5 281	227 1,140 76.4 273				
+10	+3	(192) 1:45 (145) 2:13	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,470 84.2 301	253 1,440 83.3 301	249 1,380 82.2 297	246 1,320 80.4 292	240 1,260 78.6 286	234 1,190 76.5 278	227 1,130 74.6 270				
+5	-2	(191) 1:46 (145) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,460 82.2 298	253 1,420 81.3 298	250 1,370 80.2 295	246 1,310 78.6 289	240 1,250 76.6 283	233 1,180 74.6 275	225 1,110 72.6 266				
Std.	-7	(190) 1:48 (145) 2:19	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,440 80.5 295	253 1,410 79.7 295	251 1,360 78.6 293	247 1,300 76.8 287	241 1,230 75.0 281	234 1,160 73.1 273	225 1,080 71.2 263				
-5			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 145,000 LB & LESS
Vno 262/275 KTS EAS
ALT 11,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+13	(190) 1:47 (115) 2:43	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	241 1,440 88.5 293	249 1,440 88.5 301	248 1,400 86.2 301	246 1,340 84.3 296	240 1,280 82.3 290	235 1,220 80.3 284	228 1,150 78.2 276	221 1,090 76.0 267	212 1,010 73.6 257	200 920 71.2 243	
+15	+8	(202) 1:43 (115) 2:45	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,500 88.5 306	253 1,450 86.2 304	249 1,390 84.2 299	246 1,330 82.4 294	240 1,270 80.5 288	234 1,210 78.5 281	227 1,140 76.4 273	219 1,080 74.2 263	210 1,000 72.0 252	196 910 68.9 236	
+10	+3	(205) 1:40 (125) 2:35	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,500 85.3 307	254 1,440 83.9 302	249 1,380 82.2 297	246 1,320 80.4 292	240 1,260 78.6 285	234 1,190 76.5 278	227 1,130 74.6 270	218 1,050 72.5 259	208 970 70.1 247		
+5	-2	(205) 1:41 (135) 2:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	259 1,490 83.2 305	255 1,430 81.8 300	250 1,370 80.2 295	246 1,310 78.6 289	240 1,250 76.6 283	233 1,180 74.6 275	225 1,110 72.6 266	216 1,040 70.6 255			
Std.	-7	(205) 1:41 (145) 2:19	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	260 1,480 81.6 303	255 1,420 80.1 298	251 1,360 78.6 293	247 1,300 76.8 287	241 1,230 75.0 281	234 1,160 73.1 273	225 1,080 71.2 263				
-5			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 12,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+11	(185) 1:46 (145) 2:08	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	242 1,400 88.5 299	248 1,400 88.5 306	249 1,390 88.5 306	245 1,350 85.0 301	240 1,290 83.0 295	235 1,230 81.2 289	230 1,170 79.1 283				
+15	+6	(181) 1:44 (145) 2:10	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	250 1,460 88.5 304	253 1,450 87.9 308	250 1,400 85.1 305	246 1,340 83.1 299	241 1,280 81.2 293	235 1,220 79.2 287	229 1,150 77.2 280				
+10	+1	(180) 1:45 (145) 2:13	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,470 84.9 306	253 1,440 83.9 306	251 1,390 83.4 303	247 1,330 81.4 297	241 1,260 79.6 291	236 1,200 77.4 285	229 1,130 75.2 277				
+5	-4	(181) 1:46 (145) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,460 83.0 303	253 1,430 82.1 303	251 1,380 81.4 301	247 1,320 79.6 295	241 1,260 77.6 289	236 1,190 75.8 282	229 1,110 73.5 272				
Std.	-9	(188) 1:48 (145) 2:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,440 81.4 300	253 1,410 80.5 300	252 1,370 79.5 298	247 1,310 77.8 292	241 1,240 75.8 286	235 1,170 73.9 278	226 1,090 71.8 268				
-5	-14	(188) 1:50 (145) 2:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,430 80.3 297	253 1,400 79.4 297	251 1,360 78.3 295	247 1,290 76.5 289	240 1,220 74.6 281	232 1,140 72.6 272	220 1,050 70.2 259				
-10	-19	(187) 1:51 (145) 2:27	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,420 80.4 294	253 1,380 79.5 294	251 1,340 78.6 292	247 1,270 76.9 286	239 1,200 75.0 278	230 1,120 72.6 268	217 1,020 69.4 253				
-15	-24	(187) 1:52 (145) 2:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,400 79.8 291	253 1,370 78.9 291	252 1,330 78.0 290	247 1,260 76.4 283	239 1,190 74.5 275	231 1,110 72.1 266	217 1,010 68.8 250				
-20	-29	(187) 1:53 (155) 2:16	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,390 79.2 288	253 1,350 78.3 288	252 1,320 77.6 287	247 1,250 76.0 281	240 1,180 74.0 273	231 1,100 71.7 263					
-25	-34	(186) 1:54 (155) 2:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,370 78.9 285	253 1,340 78.0 285	252 1,310 77.2 284	248 1,240 75.6 278	240 1,170 73.6 270	232 1,090 71.4 261					
-30	-39	(186) 1:55 (155) 2:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,360 78.7 282	253 1,330 77.8 282	253 1,300 77.0 282	247 1,230 75.4 275	240 1,160 73.5 268	232 1,090 71.2 259					

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 145,000 LB & LESS
Vno 262/275 KTS EAS
ALT 12,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+11	(185) 1:46 (115) 2:43	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	242 1,400 88.5 299	248 1,400 88.5 306	248 1,410 88.5 306	245 1,350 85.0 301	240 1,290 83.0 295	235 1,230 81.2 289	230 1,170 79.1 283	225 1,100 76.8 276	216 1,020 74.4 265	202 920 71.3 249	
+15	+6	(194) 1:43 (115) 2:50	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	250 1,470 88.5 304	254 1,470 88.5 310	250 1,400 85.1 305	246 1,340 83.1 299	241 1,280 81.2 293	235 1,220 79.2 287	229 1,150 77.2 280	224 1,090 75.4 272	212 1,000 72.5 259	193 880 69.1 237	
+10	+1	(205) 1:39 (125) 2:35	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	260 1,520 88.5 313	255 1,460 85.2 308	251 1,390 83.4 303	247 1,330 81.4 297	241 1,260 79.6 291	236 1,200 77.4 285	229 1,130 75.2 277	222 1,030 73.1 267	209 970 70.6 252		
+5	-4	(205) 1:39 (135) 2:25	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	260 1,510 84.9 312	256 1,440 83.2 306	252 1,380 81.4 301	247 1,320 79.6 295	241 1,260 77.6 289	236 1,190 75.8 282	227 1,110 73.5 272	217 1,030 71.4 260			
Std.	-9	(205) 1:41 (145) 2:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	260 1,490 82.8 307	256 1,430 81.1 303	252 1,370 79.5 298	247 1,310 77.8 292	241 1,240 75.8 286	235 1,170 73.9 278	226 1,090 71.8 268				
-5	-14	(205) 1:41 (145) 2:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	260 1,480 81.5 305	256 1,420 80.0 300	251 1,360 78.3 295	247 1,290 76.5 289	240 1,220 74.6 281	232 1,140 72.6 272	220 1,050 70.2 259				
-10	-19	(205) 1:42 (145) 2:27	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	261 1,470 81.7 303	256 1,410 80.2 298	251 1,340 78.6 292	247 1,270 76.9 286	239 1,200 75.0 278	230 1,120 72.6 268	217 1,020 69.4 253				
-15	-24	(205) 1:43 (145) 2:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	261 1,450 81.1 300	257 1,390 79.6 295	252 1,330 78.0 290	247 1,260 76.4 283	239 1,190 74.5 275	231 1,110 72.1 266	217 1,010 68.8 250				
-20	-29	(205) 1:44 (145) 2:16	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	262 1,440 80.6 298	257 1,380 79.2 293	252 1,320 77.6 287	247 1,250 76.0 281	240 1,180 74.0 273	231 1,100 71.7 263					
-25	-34	(205) 1:45 (145) 2:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	263 1,430 80.4 295	258 1,370 78.9 290	252 1,310 77.2 284	248 1,240 75.6 278	240 1,170 73.6 270	232 1,090 71.4 261					
-30	-39	(205) 1:46 (145) 2:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	263 1,420 80.0 293	259 1,360 78.6 288	253 1,300 77.0 282	247 1,230 75.4 275	240 1,160 73.5 268	232 1,090 71.2 259					

ZFW 155,000 LB
Vno 250 KTS FAS
ALT 13,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+9	(182) 1:50 (145) 2:11	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		237 1,360 88.5 297	244 1,370 88.5 304	242 1,320 85.7 302	237 1,260 83.6 296	232 1,200 81.6 289	225 1,140 79.4 282				
+15	+4	(191) 1:47 (145) 2:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,430 88.5 301	250 1,430 88.5 309	247 1,370 85.9 306	243 1,310 84.0 300	238 1,250 81.9 294	232 1,190 79.8 288	226 1,120 77.6 280				
+10	-1	(198) 1:45 (145) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,470 85.9 310	252 1,420 85.8 309	248 1,360 84.0 304	244 1,300 82.0 298	238 1,240 79.9 292	232 1,180 77.8 285	225 1,110 75.6 277				
+5	-6	(196) 1:45 (145) 2:16	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,460 84.0 308	253 1,420 83.6 307	248 1,360 81.9 302	244 1,290 80.0 296	239 1,230 78.0 290	232 1,170 75.8 282	225 1,100 73.8 274				
Std.	-11	(195) 1:46 (145) 2:19	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,440 82.6 305	253 1,410 81.6 305	250 1,340 79.9 300	245 1,280 78.0 294	239 1,220 76.0 287	233 1,150 74.1 280	225 1,080 72.2 271				
-5			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 145,000 LB & LESS
Vno 262/275 KTS EAS
ALT 13,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+9	(182) 1:50 (115) 2:45	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		237 1,360 88.5 297	244 1,370 88.5 304	242 1,320 85.7 302	237 1,260 83.6 296	232 1,200 81.6 289	225 1,140 79.4 282	219 1,070 77.2 274	211 1,000 74.8 264	200 910 72.3 251	
+15	+4	(191) 1:47 (115) 2:47	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,430 88.5 301	250 1,430 88.5 309	247 1,370 85.9 306	243 1,310 84.0 300	238 1,250 81.9 294	232 1,190 79.8 288	226 1,120 77.6 280	218 1,060 75.3 271	209 980 73.0 259	197 900 70.4 244	
+10	-1	(201) 1:43 (125) 2:36	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	256 1,480 88.5 313	252 1,420 85.8 309	248 1,360 84.0 304	244 1,300 82.0 298	238 1,240 79.9 292	232 1,180 77.8 285	225 1,110 75.6 277	217 1,040 73.4 267	207 960 71.2 254		
+5	-6	(205) 1:41 (125) 2:38	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	257 1,480 85.5 312	253 1,420 83.6 307	248 1,360 81.9 302	244 1,290 80.0 296	239 1,230 78.0 290	232 1,170 75.8 282	225 1,100 73.8 274	216 1,030 71.8 263	204 950 69.5 248		
Std.	-11	(205) 1:42 (135) 2:27	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,470 83.3 310	254 1,410 81.6 305	250 1,340 79.9 300	245 1,280 78.0 294	239 1,220 76.0 287	233 1,150 74.1 280	225 1,080 72.2 271	214 1,020 70.2 258			
-5			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 14,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+7	(177) 1:53 (145) 2:13	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		230 1,330 88.5 293	238 1,330 88.5 302	243 1,330 87.8 307	238 1,260 84.5 301	232 1,200 82.3 294	226 1,130 80.0 287				
+15	+2	(185) 1:48 (145) 2:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	236 1,380 88.5 298	244 1,380 88.5 307	249 1,390 88.5 313	244 1,320 84.9 306	238 1,260 82.7 299	232 1,190 80.3 292	225 1,120 78.2 284				
+10	-3	(194) 1:44 (145) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	249 1,440 88.5 310	254 1,440 86.6 316	248 1,380 85.0 309	244 1,310 82.6 303	238 1,240 80.5 296	232 1,170 78.3 289	225 1,110 76.2 281				
+5	-8	(197) 1:44 (145) 2:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,460 85.2 313	253 1,420 84.8 312	248 1,360 82.7 306	243 1,290 80.7 299	238 1,220 78.5 293	232 1,160 76.3 286	225 1,090 74.4 278				
Std.	-13	(200) 1:45 (145) 2:19	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,450 83.5 310	251 1,400 82.1 307	246 1,330 80.3 301	242 1,270 78.4 295	237 1,200 76.4 289	231 1,140 74.6 282	225 1,080 72.8 275				
-5	-18	(200) 1:46 (145) 2:21	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,430 82.3 307	251 1,390 81.0 304	246 1,320 79.1 298	241 1,250 77.2 292	236 1,190 75.4 285	229 1,120 73.6 278	222 1,060 71.7 270				
-10	-23	(199) 1:47 (145) 2:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,420 82.2 304	252 1,380 81.0 302	247 1,310 79.3 296	242 1,240 77.6 289	236 1,170 75.7 282	229 1,110 73.7 274	222 1,040 71.5 266				
-15	-28	(198) 1:50 (145) 2:27	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,400 81.6 301	252 1,360 80.4 299	247 1,300 78.8 293	241 1,230 77.0 286	235 1,160 75.1 279	228 1,100 73.0 271	219 1,020 70.7 261				
-20	-33	(198) 1:51 (145) 2:30	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,390 80.9 298	252 1,350 80.0 296	248 1,290 78.4 291	242 1,220 76.7 284	235 1,150 74.7 276	228 1,080 72.6 268	218 1,000 70.0 257				
-25	-38	(197) 1:52 (145) 2:33	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,370 80.5 295	253 1,340 79.6 294	248 1,280 78.1 288	244 1,220 76.7 283	237 1,150 74.5 275	229 1,070 72.2 266	216 980 69.4 252				
-30	-43	(195) 1:53 (145) 2:36	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,360 80.4 292	254 1,330 79.4 292	249 1,280 78.0 287	246 1,210 76.4 282	238 1,150 74.5 274	229 1,070 72.1 264	214 960 68.9 247				

ZFW 145,000 LB & LESS
Vno 262/275 KTS EAS
ALT 14,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+7	(177) 1:53 (105) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		230 1,330 88.5 293	238 1,330 88.5 302	243 1,330 87.8 307	238 1,260 84.5 301	232 1,200 82.3 294	226 1,130 80.0 287	220 1,070 77.9 280	214 1,000 75.4 271	205 920 72.7 260	189 810 69.4 240
+15	+2	(185) 1:48 (115) 2:47	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	236 1,380 88.5 298	244 1,380 88.5 307	249 1,390 88.5 313	244 1,320 84.9 306	238 1,260 82.7 299	232 1,190 80.3 292	225 1,120 78.2 284	220 1,050 75.8 277	214 990 73.5 268	202 900 71.0 254	
+10	-3	(194) 1:44 (115) 2:52	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	249 1,440 88.5 310	255 1,440 88.5 317	248 1,380 85.0 309	244 1,310 82.6 303	238 1,240 80.5 296	232 1,170 78.3 289	225 1,110 76.2 281	219 1,040 74.2 273	211 970 72.0 263	199 870 69.1 248	
+5	-8	(205) 1:41 (125) 2:38	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,490 88.5 318	253 1,420 84.8 312	248 1,360 82.7 306	243 1,290 80.7 299	238 1,220 78.5 293	232 1,160 76.3 286	225 1,090 74.4 278	218 1,020 72.5 270	210 950 70.4 259		
Std.	-13	(205) 1:43 (125) 2:40	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	256 1,460 83.9 313	251 1,400 82.1 307	246 1,330 80.3 301	242 1,270 78.4 295	237 1,200 76.4 289	231 1,140 74.6 282	225 1,080 72.8 275	218 1,01[illegible] 71.1 267	209 940 69.2 256		
-5	-18	(205) 1:43 (135) 2:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	256 1,450 82.8 310	251 1,390 81.0 304	246 1,320 79.1 298	241 1,250 77.2 292	236 1,190 75.4 285	229 1,120 73.6 278	222 1,060 71.7 270	215 990 69.9 261			
-10	-23	(205) 1:44 (135) 2:36	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,440 82.6 308	252 1,380 81.0 302	247 1,310 79.3 296	242 1,240 77.6 289	236 1,170 75.7 282	229 1,110 73.7 274	222 1,040 71.5 266	212 960 68.9 255			
-15	-28	(205) 1:45 (145) 2:27	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	257 1,430 82.0 305	252 1,360 80.4 299	247 1,300 78.8 293	241 1,230 77.0 286	235 1,160 75.1 279	228 1,100 73.0 271	219 1,020 70.7 261				
-20	-33	(205) 1:46 (145) 2:30	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,410 81.5 302	252 1,350 80.0 296	248 1,290 78.4 291	242 1,220 76.7 284	235 1,150 74.7 276	228 1,080 72.6 268	218 1,000 70.0 257				
-25	-38	(205) 1:47 (145) 2:33	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,400 81.1 299	253 1,340 79.6 294	248 1,280 78.1 288	244 1,220 76.7 283	237 1,150 74.5 275	229 1,070 72.2 266	216 980 69.4 252				
-30	-43	(205) 1:48 (145) 2:36	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	258 1,390 80.8 296	254 1,330 79.4 292	249 1,280 78.0 287	246 1,210 76.4 282	238 1,150 74.5 274	229 1,070 72.1 264	214 960 68.9 247				

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 15,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+5	(173) 1:54 (145) 2:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			232 1,300 88.5 300	241 1,310 88.5 310	236 1,250 85.6 304	231 1,190 83.5 298	225 1,120 81.1 290				
+15	0	(184) 1:50 (145) 2:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		238 1,350 88.5 305	245 1,360 88.5 314	243 1,310 85.4 309	237 1,240 83.3 303	233 1,180 81.1 297	226 1,120 78.8 289				
+10	-5	(196) 1:45 (145) 2:16	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	250 1,410 88.5 316	251 1,420 88.1 317	246 1,360 84.9 312	242 1,300 83.0 306	237 1,230 81.0 300	232 1,170 78.8 294	226 1,100 76.6 286				
+5	-10	(199) 1:44 (145) 2:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,460 87.2 318	253 1,410 85.0 316	247 1,350 83.0 310	243 1,290 80.9 304	238 1,220 78.8 298	232 1,160 76.6 291	226 1,090 74.6 283				
Std.	-15	(198) 1:45 (145) 2:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,450 84.6 315	253 1,400 83.2 314	248 1,340 81.4 308	244 1,280 79.2 203	237 1,210 77.2 295	232 1,140 75.2 288	225 1,070 73.2 280				
-5	-20	(197) 1:48 (145) 2:21	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,440 83.5 312	253 1,390 82.1 311	248 1,330 80.2 305	244 1,260 78.3 299	238 1,200 76.2 292	232 1,130 74.4 285	224 1,060 72.5 276				
-10	-25	(197) 1:49 (145) 2:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,420 83.0 309	254 1,380 82.0 308	249 1,320 80.3 303	245 1,250 78.6 297	239 1,190 76.7 290	232 1,120 74.8 282	225 1,050 72.8 274				
-15	-30	(196) 1:50 (145) 2:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,410 82.3 306	254 1,370 81.3 305	249 1,310 79.8 300	245 1,240 78.2 294	239 1,180 76.2 288	233 1,110 74.2 281	225 1,050 72.2 272				
-20	-35	(196) 1:51 (145) 2:25	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,390 81.7 302	254 1,350 80.8 302	250 1,290 79.3 297	245 1,220 77.6 291	239 1,160 75.7 284	231 1,090 73.6 276	224 1,030 71.6 268				
-25	-40	(197) 1:53 (145) 2:27	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,380 81.3 299	255 1,330 80.4 299	250 1,270 78.8 294	246 1,210 77.2 288	239 1,150 75.2 281	232 1,080 73.2 274	225 1,020 71.2 265				
-30	-45	(197) 1:54 (145) 2:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,360 81.1 296	254 1,320 80.2 296	249 1,260 78.7 290	245 1,200 76.9 285	238 1,140 75.0 278	232 1,070 73.0 271	225 1,010 71.0 263				

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 145,000 LB & LESS
Vno 262/275 KTS EAS
ALT 15,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts.											
			FF/Eng. #/hr.											
			% RPM											
			TAS Kts.											
+25			IAS Kts.											
			FF/Eng. #/hr.											
			% RPM											
			TAS Kts.											
+20	+5	(173)	IAS Kts.			232	241	236	231	225	218	212	203	194
		1:54	FF/Eng. #/hr.			1,300	1,310	1,250	1,190	1,120	1,060	980	910	830
		(105)	% RPM			88.5	88.5	85.6	83.5	81.1	78.8	76.2	73.6	70.4
		3:01	TAS Kts.			300	310	304	298	290	282	273	262	250
+15	0	(184)	IAS Kts.		238	245	243	237	233	226	218	210	201	
		1:50	FF/Eng. #/hr.		1,350	1,360	1,310	1,240	1,180	1,120	1,050	970	890	
		(115)	% RPM		88.5	88.5	85.4	83.3	81.1	78.8	76.4	74.0	71.5	
		2:48	TAS Kts.		305	314	309	303	297	289	280	269	257	
+10	-5	(196)	IAS Kts.	250	251	246	242	237	232	226	218	209	198	
		1:45	FF/Eng. #/hr.	1,410	1,420	1,360	1,300	1,230	1,170	1,100	1,030	950	850	
		(115)	% RPM	88.5	88.1	84.9	83.0	81.0	78.8	76.6	74.4	72.0	69.2	
		2:56	TAS Kts.	316	317	312	306	300	294	286	277	265	250	
+5	-10	(205)	IAS Kts.	256	253	247	243	238	232	226	218	207		
		1:42	FF/Eng. #/hr.	1,470	1,410	1,350	1,290	1,220	1,160	1,090	1,010	920		
		(125)	% RPM	88.0	85.0	83.0	80.9	78.8	76.6	74.6	72.5	70.2		
		2:43	TAS Kts.	320	316	310	304	298	291	283	274	260		
Std.	-15	(205)	IAS Kts.	256	253	248	244	237	232	225	218	205		
		1:42	FF/Eng. #/hr.	1,470	1,400	1,340	1,280	1,210	1,140	1,070	1,000	910		
		(125)	% RPM	85.1	83.2	81.4	79.2	77.2	75.2	73.2	71.2	68.9		
		2:45	TAS Kts.	318	314	308	302	295	288	280	271	255		
-5	-20	(205)	IAS Kts.	257	253	248	244	238	232	224	218			
		1:43	FF/Eng. #/hr.	1,450	1,390	1,330	1,260	1,200	1,130	1,060	980			
		(135)	% RPM	83.9	82.1	80.2	78.3	76.2	74.4	72.5	70.6			
		2:33	TAS Kts.	315	311	305	299	292	285	276	268			
-10	-25	(205)	IAS Kts.	258	254	249	245	239	232	225	217			
		1:44	FF/Eng. #/hr.	1,440	1,380	1,320	1,250	1,190	1,120	1,050	970			
		(135)	% RPM	83.4	82.0	80.3	78.6	76.7	74.8	72.8	70.4			
		2:35	TAS Kts.	313	308	303	297	290	282	274	265			
-15	-30	(205)	IAS Kts.	258	254	249	245	239	233	225	217			
		1:45	FF/Eng. #/hr.	1,430	1,370	1,310	1,240	1,180	1,110	1,050	970			
		(135)	% RPM	82.6	81.3	79.8	78.2	76.2	74.2	72.2	70.0			
		2:35	TAS Kts.	310	305	300	294	288	281	272	263			
-20	-35	(205)	IAS Kts.	257	254	250	245	239	231	224	216			
		1:46	FF/Eng. #/hr.	1,410	1,350	1,290	1,220	1,160	1,090	1,030	960			
		(135)	% RPM	82.1	80.8	79.3	77.6	75.7	73.6	71.6	69.4			
		2:36	TAS Kts.	306	302	297	291	284	276	268	259			
-25	-40	(205)	IAS Kts.	257	255	250	246	239	232	225	217			
		1:48	FF/Eng. #/hr.	1,390	1,330	1,270	1,210	1,150	1,080	1,020	950			
		(135)	% RPM	81.7	80.4	78.8	77.2	75.2	73.2	71.2	69.0			
		2:38	TAS Kts.	303	299	294	288	281	274	265	257			
-30	-45	(205)	IAS Kts.	257	254	249	245	238	232	225	216			
		1:49	FF/Eng. #/hr.	1,380	1,320	1,260	1,200	1,140	1,070	1,010	940			
		(135)	% RPM	81.6	80.2	78.7	76.9	75.0	73.0	71.0	68.9			
		2:40	TAS Kts.	300	296	290	285	278	271	263	254			

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 16,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C. DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+3	(170) 1:57 (145) 2:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			225 1,270 88.5 296	234 1.280 88.5 306	236 1.250 86.2 309	231 1,190 83.8 302	225 1.120 81.5 295				
+15	-2	(180) 1:53 (145) 2:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		231 1,320 88.5 301	239 1.330 88.5 310	241 1,310 86.6 312	237 1,240 84.1 307	231 1,180 82.0 300	225 1,110 79.6 293				
+10	-7	(190) 1:48 (145) 2:16	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,380 88.5 313	249 1,380 88.5 320	246 1,360 86.6 316	242 1,300 84.2 310	236 1,230 82.2 305	232 1,170 79.9 298	225 1,100 77.7 290				
+5	-12	(200) 1:44 (145) 2:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,440 88.5 324	251 1,410 87.6 319	247 1,350 84.1 314	243 1,290 82.2 308	238 1,220 80.2 302	232 1,160 78.0 295	225 1,090 75.8 287				
Std.	-17	(203) 1:43 (145) 2:19	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,450 85.8 320	252 1,400 84.1 317	247 1,340 82.3 312	243 1 280 80.3 306	237 1,210 78.2 300	232 1,140 76.2 293	225 1,080 74.2 285				
-5	-22	(203) 1:45 (145) 2:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,450 84.4 317	251 1 380 82.8 313	247 1,320 81.0 308	243 1.260 79.0 303	238 1,190 77.0 296	231 1,120 75.2 288	224 1,060 72.4 280				
-10	-27	(204) 1:46 (14 5) 2:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,430 83.9 314	251 1,370 82.5 310	247 1,300 80.9 305	243 1,240 79.2 299	238 1,180 77.3 293	231 1,110 75.3 285	224 1,050 73.1 277				
-15	-32	(204) 1:47 (145) 2:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,410 83.0 311	251 1,350 81.7 307	247 1,290 80.1 302	243 1,230 78.4 296	237 1,170 76.6 290	231 1,100 74.8 282	223 1,030 72.6 273				
-20	-37	(204) 1:48 (145) 2:27	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,400 82.6 308	251 1,340 81.2 304	247 1.280 79.6 299	243 1 220 78.0 293	237 1,160 76.2 287	231 1,090 74.4 280	222 1,020 72.2 270				
-25	-42	(203) 1:49 (145) 2:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,380 82.1 304	252 1.330 80.8 301	247 1,270 79.2 296	243 1,210 77.6 290	237 1,140 75.8 284	231 1,080 74.0 276	223 1,010 71.8 268				
-30	-47	(202) 1:51 (145) 2:30	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,370 81.8 301	252 1.310 80.6 298	247 1,260 79.0 293	244 1,200 77.4 288	238 1,130 75.6 281	231 1,070 73.7 274	223 1,000 71.6 265				

ZFW 145,000 LB & LESS
Vno 262/275 KTS EAS
ALT 16,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+3	(170) 1:57 (105) 3:03	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			225 1,270 88.5 296	234 1,280 88.5 306	236 1,250 86.2 309	231 1 190 83.8 302	225 1,120 81.5 295	219 1,060 79.8 287	212 980 76.4 278	204 910 73.9 267	192 820 71.3 252
+15	-2	(180) 1:53 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		231 1,320 88.5 301	239 1,330 88.5 310	241 1,310 86.6 312	237 1,240 84.1 307	231 1,180 82.0 300	225 1,110 79.6 293	218 1,040 77.3 284	211 970 74.7 274	202 890 72.2 262	191 800 69.4 248
+10	-7	(190) 1:48 (115) 2:52	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,380 88.5 313	249 1,380 88.5 320	246 1,360 86.6 316	242 1,300 84.2 310	238 1 230 82.2 305	232 1,170 79.9 298	225 1,100 77.3 290	218 1,030 75.3 281	210 950 73.0 270	202 870 70.8 259	
+5	-12	(200) 1:44 (115) 2:54	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,440 88.5 324	251 1,410 86.7 319	247 1,350 84.1 314	243 1,290 82.2 308	238 1 220 80.2 302	232 1,160 78.0 295	225 1,090 75.8 287	219 1,020 73.8 278	209 940 71.6 266	200 860 69.5 255	
Std.	-17	(203) 1:43 (125) 2:43	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,450 85.8 320	252 1,400 84.1 317	247 1,340 82.3 312	243 1,280 80.3 306	237 1,210 78.2 299	231 1,140 76.2 292	224 1,080 74.2 284	217 1,000 72.2 274	209 920 70.1 263		
-5	-22	(205) 1:43 (125) 2:45	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,450 84.5 318	251 1,380 82.8 313	247 1,320 81.0 308	243 1,260 79.0 303	238 1,190 77.0 296	231 1,120 75.2 288	224 1,060 72.4 280	215 990 70.2 270	208 910 69.2 260		
-10	-27	(205) 1:45 (135) 2:35	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,430 84.0 315	251 1,370 82.5 310	247 1,300 80.9 305	243 1,240 79.2 299	238 1,180 77.3 293	231 1,110 75.3 285	224 1,050 73.1 277	215 970 70.7 266			
-15	-32	(205) 1:47 (135) 2:36	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,410 83.2 311	251 1,350 81.7 307	247 1,290 80.1 302	243 1,230 78.4 296	237 1,170 76.6 290	231 1,100 74.8 282	223 1,030 72.6 273	214 960 70.1 263			
-20	-37	(205) 1:47 (135) 2:40	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,400 82.7 308	251 1,340 81.2 304	247 1,280 79.6 299	243 1,220 78.0 293	237 1,160 76.2 287	231 1 090 74.4 280	222 1,020 72.2 270	214 940 69.7 260			
-25	-42	(205) 1:48 (135) 2:41	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	255 1,390 82.2 305	252 1,330 80.8 301	247 1,270 79.2 296	243 1,210 77.6 290	237 1,140 75.8 284	231 1,080 74.0 276	223 1,010 71.8 268	213 930 69.0 256			
-30	-47	(205) 1:50 (145) 2:30	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	306 1,370 82.0 302	252 1,310 80.6 298	247 1,260 79.0 293	244 1,200 77.4 288	238 1,130 75.6 281	231 1,070 73.7 274	223 1,000 71.6 265				

ZFW 155,000 LB & LESS
Vno 250/262/295 KTS EAS
ALT 17,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+1	(166) 2:02 (105) 3:00	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			220 1,240 88.5 295	229 1,240 88.5 304	234 1,230 87.9 310	229 1,170 84.6 304	224 1,110 82.2 298	217 1,040 79.8 290	212 980 77.0 281	204 910 74.5 271	194 830 71.7 258
+15	-4	(176) 1:56 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			232 1,290 88.5 307	239 1,290 88.1 315	236 1,220 84.9 310	230 1,160 82.7 303	224 1,100 80.3 296	217 1,030 77.8 287	211 960 75.3 278	202 890 72.8 266	191 800 70.0 252
+10	-9	(185) 1:52 (115) 2:52	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		237 1,340 88.5 310	243 1,340 88.5 318	239 1,280 85.1 312	235 1,220 82.9 306	230 1,150 80.7 300	224 1,090 78.4 293	217 1,020 76.0 284	210 950 73.6 274	200 870 71.2 261	
+5	-14	(195) 1:48 (115) 2:56	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	242 1,400 88.5 312	250 1,400 88.5 322	243 1,330 85.1 315	241 1,270 83.0 310	235 1,210 81.0 304	230 1,140 78.8 297	224 1,080 76.4 290	217 1,010 74.2 281	209 930 72.0 270	199 850 69.6 257	
Std.	-19	(205) 1.44 (125) 2:43	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	252 1,440 88.3 322	248 1,380 85.1 318	243 1,320 83.2 312	241 1,260 81.2 307	235 1,200 79.0 301	230 1,140 76.8 295	224 1,070 74.8 287	217 1,000 72.7 278	208 920 70.6 266		
-5	-24	(205) 1:45 (125) 2:45	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,430 85.2 320	249 1,370 83.3 315	245 1,310 81.4 310	241 1,250 79.4 305	236 1,190 77.4 299	230 1,120 75.5 292	224 1,060 73.7 284	216 980 71.7 275	207 910 69.7 263		
-10	-29	(205) 1:46 (125) 2:48	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,420 84.6 317	249 1,360 83.0 313	246 1,300 81.3 308	241 1,240 79.6 302	236 1,180 77.8 296	231 1,110 76.0 289	224 1,040 74.0 281	216 970 71.6 272	206 890 69.0 259		
-15	-34	(205) 1:46 (135) 2:38	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,410 83.9 314	249 1,350 82.3 309	246 1,290 80.7 305	241 1,220 79.0 299	236 1,160 77.2 293	231 1,100 75.4 286	223 1,030 73.4 277	215 950 71.0 267			
-20	-39	(205) 1:48 (135) 2:38	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,390 83.4 311	250 1,330 81.8 307	246 1,280 80.2 302	242 1,220 78.6 297	237 1,150 76.8 291	231 1,090 75.0 284	223 1,020 72.8 275	215 950 70.4 265			
-25	-44	(205) 1:49 (135) 2:41	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,380 83.0 308	250 1,320 81.5 304	246 1,260 79.9 299	242 1,200 78.3 294	237 1,140 76.6 287	231 1,070 74.7 280	223 1,010 72.6 272	214 930 70.0 261			
-30	-49	(205) 1:50 (135) 2:43	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	254 1,360 82.7 305	251 1,310 81.2 301	247 1,250 79.7 296	242 1,190 78.1 291	237 1,120 76.4 285	231 1,060 74.5 278	223 990 72.2 269	215 920 69.6 259			

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB & LESS
Vno 250/262/275 KTS EAS
ALT 18,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-1	(161) 2:04 (105) 3:03	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				222 1,210 88.5 301	229 1,210 88.5 310	229 1,170 85.2 309	222 1,100 83.0 301	217 1,040 80.6 294	211 970 78.0 285	204 900 75.3 276	195 820 72.6 264
+15	-6	(170) 2:00 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			226 1,260 88.5 304	234 1,260 88.5 313	235 1,230 86.3 314	229 1,160 83.6 307	223 1,100 81.2 299	217 1,030 78.5 291	211 960 75.8 282	202 890 73.5 271	192 800 70.7 257
+10	-11	(180) 1:55 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		232 1,300 88.5 308	239 1,310 88.5 317	241 1,280 85.9 318	236 1,220 83.9 312	230 1,160 81.6 305	224 1,090 79.0 297	217 1,020 76.6 288	210 940 74.2 279	201 870 71.9 267	191 800 69.6 253
+5	-16	(189) 1:50 (115) 2:56	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	236 1,360 88.5 310	244 1,360 88.5 320	245 1,340 86.7 321	241 1,280 84.1 316	237 1,210 81.8 310	231 1,150 79.6 303	223 1,080 77.4 294	216 1,000 74.8 285	209 930 72.6 275	199 850 70.2 262	
Std.	-21	(203) 1:44 (125) 2:45	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	250 1,430 88.5 324	248 1,390 85.7 323	245 1,320 83.9 319	242 1,260 82.0 314	237 1,200 80.0 308	232 1,140 77.7 301	224 1,070 75.5 292	216 990 73.4 282	209 910 71.2 271		
-5	-26	(205) 1:45 (125) 2:47	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	252 1,430 85.9 324	249 1,370 84.2 320	245 1,310 82.4 315	241 1,250 80.6 310	237 1,190 78.6 304	231 1,120 76.5 297	224 1,050 74.4 289	217 980 72.4 280	208 900 70.2 268		
-10	-31	(205) 1:46 (125) 2:48	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	252 1,420 85.3 321	249 1,360 83.8 317	245 1,300 82.2 312	241 1,240 80.5 306	235 1,180 78.8 300	230 1,110 76.8 293	223 1,040 74.8 285	215 970 72.5 276	207 890 70.0 265		
-15	-36	(205) 1:47 (125) 2:48	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	253 1,400 84.6 318	249 1,340 83.0 313	244 1,280 81.5 308	241 1,220 79.8 302	236 1,160 78.0 297	230 1,100 76.0 290	223 1,030 74.0 282	216 960 71.8 273	209 890 69.4 263		
-20	-41	(205) 1:48 (135) 2:40	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	252 1,390 84.0 314	248 1,330 82.6 310	244 1,270 81.0 305	241 1,210 79.4 300	236 1,150 77.6 294	230 1,090 75.7 287	223 1,020 73.6 279	215 940 71.2 269			
-25	-46	(205) 1:49 (135) 2:41	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	252 1,370 83.7 310	248 1,310 82.2 306	244 1,260 80.6 302	241 1,200 79.0 297	237 1,140 77.2 292	231 1,080 75.4 285	223 1,000 73.2 276	213 930 70.8 264			
-30	-51	(205) 1:50 (135) 2:45	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	252 1,360 83.3 307	248 1,300 81.8 303	245 1,240 80.3 299	242 1,190 78.7 295	238 1,130 77.0 290	232 1,070 75.2 283	224 1,000 73.0 274	211 910 69.9 259			

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB & LESS
Vno 250/262/275 KTS EAS
ALT 19,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-3	(158) 2:09 (105) 3:03	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				216 1,180 88.5 297	224 1,180 88.5 308	226 1,160 86.9 311	221 1,100 83.9 304	216 1,030 81.3 297	210 970 78.8 289	203 890 75.8 279	193 820 73.0 266
+15	-8	(167) 2:02 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			219 1,220 88.5 300	228 1,230 88.5 311	232 1,210 87.6 315	227 1,150 84.4 309	221 1,090 81.8 302	215 1,020 79.2 294	210 950 76.6 286	202 880 74.0 275	192 800 71.2 261
+10	-13	(176) 1:58 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			232 1,270 88.5 313	236 1,270 87.8 318	232 1,210 84.6 312	227 1,140 82.3 306	222 1,080 79.9 299	216 1,010 77.4 292	209 940 74.8 282	200 870 72.4 270	189 780 69.6 255
+5	-18	(186) 1:53 (115) 2:56	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		236 1,330 88.5 316	240 1,320 88.3 321	236 1,260 84.8 315	232 1,200 82.6 310	227 1,130 80.3 304	222 1,070 78.0 297	216 1,000 75.7 289	209 930 73.2 279	199 850 70.9 266	
Std.	-23	(196) 1:50 (115) 2:58	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	241 1,380 88.5 319	245 1,370 88.3 323	240 1,310 85.0 318	237 1,250 82.8 313	232 1,190 80.7 307	228 1,130 78.5 301	222 1,060 76.2 294	216 990 73.9 286	208 920 71.7 275	197 840 69.4 261	
-5	-28	(205) 1:48 (125) 2:47	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	248 1,420 87.8 325	245 1,360 85.0 321	240 1,300 83.0 316	238 1,240 81.1 310	233 1,180 79.1 305	228 1,120 77.1 298	222 1,050 75.0 291	216 980 73.0 283	208 900 71.0 272		
-10	-33	(205) 1:46 (125) 2:48	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	249 1,410 86.0 323	246 1,350 84.4 318	240 1,290 82.8 313	238 1,230 81.0 308	233 1,170 79.2 302	228 1,100 77.4 296	222 1,040 75.4 289	216 970 73.3 280	207 890 70.6 269		
-15	-38	(205) 1:48 (125) 2:50	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	250 1,390 85.3 320	246 1,330 83.7 315	242 1,270 82.1 310	238 1,210 80.4 305	234 1,150 78.6 299	228 1,090 76.8 293	222 1,020 74.8 285	216 950 72.6 277	207 880 70.0 265		
-20	-43	(205) 1:49 (125) 2:54	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	250 1,380 84.9 317	246 1,320 83.4 312	242 1,260 81.7 307	239 1,200 80.0 302	235 1,140 78.2 297	228 1,080 76.4 290	222 1,010 74.4 283	215 940 72.1 274	206 860 69.3 262		
-25	-48	(205) 1:49 (125) 2:56	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	251 1,370 84.6 314	246 1,310 83.0 309	242 1,250 81.4 304	239 1,190 79.7 299	235 1,130 78.0 294	229 1,070 76.0 287	223 1,000 74.0 280	215 930 71.6 271	206 850 68.8 258		
±0	-53	(205) 1:51 (135) 2:43	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	251 1,350 84.4 311	247 1,290 82.8 306	243 1,230 81.2 302	240 1,180 79.4 297	235 1,120 77.6 291	230 1,050 75.8 285	223 990 73.7 277	216 920 71.3 268			

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB & LESS
Vno 250/262/275 KTS EAS
ALT 20,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts.											
			FF/Eng. #/hr.											
			% RPM											
			TAS Kts.											
+25			IAS Kts.											
			FF/Eng. #/hr.											
			% RPM											
			TAS Kts.											
+20	-5	(154)	IAS Kts.					218	225	221	215	209	200	190
		2:10	FF/Eng. #/hr.					1,150	1,150	1,090	1,020	950	880	800
		(105)	% RPM					88.5	88.5	84.5	82.1	79.1	76.3	73.3
		3:07	TAS Kts.					305	315	309	301	292	280	265
+15	-10	(162)	IAS Kts.				222	229	227	221	215	208	200	188
		2:05	FF/Eng. #/hr.				1,190	1,200	1,150	1,080	1,010	940	870	780
		(105)	% RPM				88.5	88.5	85.1	82.6	80.1	77.4	74.4	71.5
		3:12	TAS Kts.				307	317	314	306	298	288	276	260
+10	-15	(170)	IAS Kts.			225	233	232	228	222	215	208	199	186
		2:00	FF/Eng. #/hr.			1,240	1,240	1,210	1,140	1,070	1,000	930	860	770
		(105)	% RPM			88.5	88.5	85.7	83.2	80.7	78.2	75.6	73.0	69.8
		3:15	TAS Kts.			310	319	318	312	305	296	285	273	255
+5	-20	(180)	IAS Kts.		230	237	238	233	229	223	216	208	199	
		1:56	FF/Eng. #/hr.		1,290	1,290	1,250	1,190	1,130	1,060	1,000	920	840	
		(115)	% RPM		88.5	88.5	85.7	83.4	81.2	78.8	76.3	74.0	71.5	
		2:58	TAS Kts.		312	322	322	316	310	302	294	282	270	
Std.	-25	(193)	IAS Kts.	234	242	240	238	234	229	224	217	210	200	
		1:52	FF/Eng. #/hr.	1,340	1,340	1,310	1,250	1,190	1,130	1,070	1,000	920	840	
		(115)	% RPM	88.5	88.5	85.5	83.5	81.4	79.3	77.1	74.8	72.5	70.2	
		2:58	TAS Kts.	315	325	323	319	314	308	301	292	281	269	
-5	-30	(201)	IAS Kts.	247	244	240	238	234	230	224	216	208	197	
		1:47	FF/Eng. #/hr.	1,400	1,350	1,300	1,230	1,170	1,110	1,050	980	900	820	
		(115)	% RPM	88.5	86.2	84.2	82.3	80.2	78.1	75.9	73.8	71.6	69.3	
		3:02	TAS Kts.	328	324	320	316	311	305	298	288	276	263	
-10	-35	(205)	IAS Kts.	247	244	242	238	235	229	223	216	207		
		1:47	FF/Eng. #/hr.	1,400	1,340	1,280	1,220	1,160	1,100	1,040	960	880		
		(125)	% RPM	87.0	85.4	83.8	82.1	80.3	78.4	76.2	73.8	71.2		
		2:50	TAS Kts.	325	322	318	313	308	301	294	285	273		
-15	-40	(205)	IAS Kts.	248	245	241	239	234	229	222	215	206		
		1:49	FF/Eng. #/hr.	1,380	1,320	1,260	1,200	1,150	1,090	1,020	950	870		
		(125)	% RPM	85.9	84.5	83.0	81.3	79.6	77.8	75.7	73.3	70.6		
		2:52	TAS Kts.	322	319	314	310	304	298	290	281	269		
-20	-45	(205)	IAS Kts.	248	245	241	238	234	229	222	214	205		
		1:49	FF/Eng. #/hr.	1,370	1,310	1,250	1,190	1,130	1,070	1,010	940	860		
		(125)	% RPM	85.4	83.8	82.3	80.7	79.0	77.2	75.1	72.7	69.8		
		2:54	TAS Kts.	319	315	311	306	301	295	287	277	264		
-25	-50	(205)	IAS Kts.	248	245	241	238	234	229	223	215	205		
		1:51	FF/Eng. #/hr.	1,350	1,300	1,230	1,170	1,120	1,060	1,000	930	840		
		(125)	% RPM	84.9	83.4	81.8	80.2	78.5	76.7	74.8	72.4	69.3		
		2:58	TAS Kts.	315	311	307	302	297	291	284	275	261		
-30	-55	(205)	IAS Kts.	246	244	240	238	234	229	223	216	204		
		1:53	FF/Eng. #/hr.	1,330	1,270	1,210	1,160	1,110	1,050	990	920	830		
		(125)	% RPM	84.6	82.9	81.3	79.7	78.1	76.4	74.6	72.3	68.8		
		3:00	TAS Kts.	310	307	303	299	294	288	281	273	256		

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB & LESS
Vno 250/262/275 KTS EAS
ALT 21,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#)	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+5			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
Std.	-27	(187) 1:55 (115) 2:58	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		234 1,310 88.5 320	241 1,300 87.8 329	237 1,230 84.5 323	233 1,170 82.4 317	227 1,110 80.1 310	222 1,050 77.8 303	217 990 75.2 295	209 920 72.9 285	200 840 70.6 272	
-5	-32	(198) 1:50 (115) 3:00	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	239 1,370 88.5 323	244 1,350 87.3 328	240 1,290 84.8 324	237 1,220 82.8 319	232 1,160 80.8 313	227 1,100 78.8 307	222 1,040 76.5 300	216 980 74.3 292	209 910 72.2 282	198 830 69.9 268	
-10	-37	(205) 1:47 (115) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	246 1,400 87.4 328	243 1,340 85.8 324	239 1,280 84.2 319	237 1,210 82.5 315	232 1,150 80.8 309	227 1,090 78.9 304	222 1,030 77.0 297	215 970 74.9 289	209 890 72.4 280	197 810 69.2 264	
-15	-42	(205) 1:48 (115) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	245 1,390 86.9 323	241 1,330 85.3 319	239 1,270 83.6 315	236 1,200 82.0 311	232 1,140 80.2 306	227 1,080 78.4 300	222 1,020 76.4 294	216 950 74.4 286	208 880 71.9 276	198 800 68.8 263	
-20	-47	(205) 1:49 (125) 2:52	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	245 1,380 86.5 320	242 1,320 84.8 316	238 1,250 83.2 312	236 1,190 81.5 308	232 1,130 79.8 303	227 1,070 78.0 298	222 1,010 76.0 291	216 940 73.9 283	209 870 71.5 274		
-25	-52	(205) 1:50 (125) 2:56	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	246 1,360 86.2 318	243 1,300 84.6 314	239 1,240 83.0 310	236 1,180 81.3 305	232 1,120 79.5 300	228 1,060 77.6 295	221 1,000 75.6 288	216 930 73.5 280	208 850 71.0 270		
-30	-57	(205) 1:51 (125) 2:58	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	247 1,350 86.2 316	244 1,290 84.4 312	240 1,230 82.7 307	237 1,170 81.0 303	233 1,110 79.2 298	228 1,050 77.3 292	222 990 75.2 285	217 920 73.0 277	208 840 70.6 267		

ZFW 155,000 LB & LESS
Vno 250/262/275 KTS EAS
ALT 22,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-9	(147) 2:10 (105) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						213 1,080 88.5 308	219 1,070 87.3 316	214 1,010 83.8 309	209 950 81.0 301	201 880 78.2 291	19 810 75.2 279
+15	-14	(153) 2:12 (105) 3:10	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					217 1,130 88.5 311	225 1,130 88.5 321	220 1,070 84.5 315	214 1,010 82.0 307	209 940 79.0 298	201 870 76.2 287	192 790 73.5 274
+10	-19	(162) 2:07 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				223 1,170 88.5 315	229 1,170 88.5 324	226 1,130 85.2 320	221 1,070 82.9 313	215 1,010 80.1 305	209 940 77.4 296	201 860 74.4 285	190 780 71.9 270
+5	-24	(171) 2:02 (105) 3:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			224 1,220 88.5 316	233 1,220 88.5 325	231 1,180 85.3 323	227 1,130 83.2 318	222 1,060 80.7 311	216 1,000 78.1 303	210 930 75.4 294	202 850 72.8 282	190 770 70.6 266
Std.	-29	(184) 1:57 (105) 3:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			235 1,280 88.5 326	235 1,230 85.4 325	232 1,180 83.1 321	229 1,120 81.0 316	224 1,060 78.8 310	218 990 76.4 302	212 920 74.1 292	202 840 71.6 280	191 760 68.9 264
-5	-34	(192) 1:54 (115) 3:03	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		240 1,340 88.5 329	237 1,270 85.7 325	235 1,220 83.9 321	231 1,170 81.9 317	227 1,110 79.8 312	222 1,040 77.6 305	216 980 75.4 297	208 900 73.0 285	197 820 70.4 271	
-10	-39	(204) 1:49 (115) 3:10	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	244 1,400 88.5 331	240 1,320 86.8 326	238 1,260 85.2 323	235 1,210 83.6 319	231 1,150 81.8 314	227 1,090 80.0 308	222 1,030 78.0 302	215 960 75.8 293	206 880 73.0 280	193 790 68.9 263	
-15	-44	(205) 1:47 (125) 2:52	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	247 1,400 88.5 331	241 1,310 86.0 323	238 1,250 84.3 319	235 1,190 82.7 315	231 1,130 81.0 310	227 1,080 79.2 305	221 1,020 77.3 298	214 950 75.1 289	206 870 72.3 277		
-20	-49	(205) 1:50 (125) 2:54	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	244 1,360 87.2 324	240 1,300 85.4 320	238 1,240 83.7 316	235 1,180 82.2 312	232 1,120 80.6 308	227 1,060 78.9 302	221 1,000 76.9 295	215 940 74.7 287	207 860 71.9 275		
-25	-54	(205) 1:51 (125) 2:56	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	244 1,350 86.8 320	240 1,290 85.0 316	238 1,230 83.4 313	236 1,170 81.8 309	231 1,110 80.1 304	227 1,050 78.4 299	221 990 76.4 292	215 930 74.3 284	206 850 71.6 272		
-30	-57	(205) 1:53 (125) 2:56	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,330 86.6 316	240 1,280 85.0 313	237 1,220 83.3 310	235 1,150 81.6 306	231 1,100 80.0 301	227 1,040 78.1 296	222 990 76.2 290	215 920 74.2 282	208 850 71.6 272		

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB & LESS
Vno 250/262/275 KTS EAS
ALT 23,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+5			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
Std.	-31	(178) 2:01 (105) 3:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			227 1,240 88.5 322	234 1,240 87.2 328	229 1,180 84.1 323	225 1,120 81.8 317	221 1,060 79.3 311	215 990 76.8 303	209 920 74.4 294	200 850 72.0 282	188 770 69.2 265
-5	-36	(184) 1:57 (115) 3:00	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		232 1,290 88.5 324	238 1,300 88.5 333	233 1,220 85.1 324	229 1,160 82.9 319	225 1,100 80.7 314	221 1,040 78.2 308	215 970 75.8 300	209 910 73.6 292	199 830 71.3 279	
-10	-41	(195) 1:53 (115) 3:03	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		238 1,320 88.5 328	235 1,270 86.6 324	233 1,210 84.6 320	229 1,150 82.7 316	225 1,090 80.7 311	221 1,030 78.6 305	215 960 76.4 298	209 900 74.0 289	200 820 71.4 276	
-15	-46	(200) 1:52 (115) 3:03	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	240 1,350 88.5 327	238 1,310 87.7 324	235 1,250 85.9 321	233 1,190 84.0 317	229 1,130 82.2 312	226 1,080 80.2 308	221 1,020 78.2 302	216 960 76.2 295	210 890 73.9 287	202 820 71.2 276	
-20	-51	(203) 1:52 (115) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	242 1,360 88.5 326	238 1,290 87.1 321	235 1,230 85.3 318	233 1,170 83.4 314	229 1,120 81.6 309	225 1,060 79.6 304	221 1,010 77.6 299	216 940 75.5 292	210 880 73.2 284	201 810 70.6 272	
-25	-56	(205) 1:51 (115) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,360 88.5 324	238 1,290 86.6 319	236 1,230 84.8 315	234 1,170 83.0 311	229 1,110 81.2 306	226 1.060 79.3 302	221 1,000 77.2 296	215 940 75.2 289	210 870 72.9 281	200 800 70.4 269	
-30	-57	(205) 1:51 (115) 3:10	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	242 1,360 88.5 322	238 1,290 86.4 318	235 1,220 84.6 313	233 1,160 82.6 309	229 1,100 80.8 304	225 1,050 78.9 298	219 990 77.0 292	214 930 74.8 285	209 860 72.7 277	200 790 70.2 267	

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB & LESS
Vno 250/262/275 KTS EAS
ALT 24,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-13	(141) 2:24 (105) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						201 1,030 88.5 301	210 1,030 88.5 314	212 1,010 85.9 317	207 940 83.1 309	201 880 80.1 300	194 810 77.1 289
+15	-18	(148) 2:19 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						213 1,080 88.5 315	217 1,060 86.5 321	213 1,000 83.8 315	208 940 81.0 307	201 870 78.1 297	194 800 75.2 286
+10	-23	(157) 2:14 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					217 1,110 88.5 318	221 1,110 87.8 324	218 1,050 84.2 319	213 1,0[illegible]0 81.9 313	209 930 79.2 305	201 860 76.3 294	193 780 73.4 282
+5	-28	(167) 2:08 (105) 3:15	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				219 1,150 88.5 317	227 1,1[illegible] 87.9 328	223 1,100 84.5 322	218 1,050 82.3 316	213 990 79.8 310	209 920 77.2 302	200 850 74.4 290	191 770 71.6 277
Std.	-33	(174) 2:04 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				229 1,210 88.5 328	227 1,160 85.0 3[illegible]5	223 1,090 82.5 320	219 1,040 80.1 314	214 980 77.7 308	209 910 75.2 299	200 840 72.7 2[illegible]8	188 750 69.9 270
-5	-38	(182) 2:00 (105) 3:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			231 1,260 88.5 329	230 1,210 85.8 326	227 1,150 83.7 322	224 1,090 81.4 318	219 1,030 79.2 312	215 970 77.0 306	209 910 74.8 297	2[illegible]0 830 72.4 286	186 740 69.2 265
-10	-43	(194) 1:55 (115) 3:00	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		236 1,320 88.5 331	232 1,260 86.7 326	231 1,200 85.0 323	227 1,140 83.2 319	223 1,080 81.4 314	220 1,020 79.6 309	215 960 77.7 303	211 900 75.5 296	203 830 72.7 285	
-15	-48	(199) 1:54 (115) 3:03	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		236 1,290 87.6 327	233 1,240 86.0 323	231 1,180 84.4 320	228 1,120 82.7 316	224 1,060 80.9 311	220 1,010 79.0 306	216 950 77.[illegible] 300	211 890 75.0 293	203 820 72.5 282	
-20	-53	(199) 1:54 (115) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	233 1,310 88.5 320	237 1,280 87.5 325	234 1,220 85.5 321	231 1,160 83.8 317	228 1,110 82.2 313	225 1,050 80.4 308	221 1,000 78.6 303	217 940 76.6 298	212 880 74.6 290	204 810 71.9 280	
-25	-57	(200) 1:54 (115) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	235 1,310 88.5 320	238 1,280 87.3 323	234 1,210 85.3 319	232 1,150 83.6 315	228 1,100 81.8 310	225 1,040 80.0 306	221 990 78.2 300	216 940 76.2 294	211 870 74.1 287	204 800 71.6 277	
-30	-57	(200) 1:54 (115) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	234 1,310 88.5 319	236 1,280 87.3 321	233 1,200 85.4 317	230 1,140 83.5 312	226 1,090 81.6 307	222 1,030 79.8 302	218 980 77.9 297	213 920 76.0 290	208 860 73.8 283	202 800 71.4 274	

ZFW 155,000 LB & LESS
Mno .62
ALT 26,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts.											
			FF/Eng. #/hr.											
			% RPM											
			TAS Kts.											
+25			IAS Kts.											
			FF/Eng. #/hr.											
			% RPM											
			TAS Kts.											
+20	-17	(132)	IAS Kts.							197	205	206	200	192
		2:33	FF/Eng. #/hr.							970	980	940	870	800
		(105)	% RPM							88.5	88.5	85.1	82.0	79.0
		3:07	TAS Kts.							305	318	318	308	297
+15	-22	(140)	IAS Kts.							208	210	206	200	193
		2:27	FF/Eng. #/hr.							1,020	990	930	860	800
		(105)	% RPM							88.5	85.7	82.9	80.0	76.9
		3:07	TAS Kts.							319	322	315	306	295
+10	-27	(147)	IAS Kts.						209	216	211	206	200	192
		2:23	FF/Eng. #/hr.						1,050	1,050	990	920	860	780
		(105)	% RPM						88.5	86.9	83.8	81.0	78.0	74.8
		3:12	TAS Kts.						318	327	320	312	303	291
+5	-32	(158)	IAS Kts.					210	221	217	212	207	200	189
		2:16	FF/Eng. #/hr.					1,090	1,100	1,040	980	910	850	770
		(105)	% RPM					88.5	86.9	84.2	81.8	79.0	76.0	73.0
		3:15	TAS Kts.					316	330	325	318	310	299	284
Std.	-37	(164)	IAS Kts.					222	221	217	213	208	199	188
		2:12	FF/Eng. #/hr.					1,140	1,090	1,030	980	910	840	750
		(105)	% RPM					88.5	84.9	82.5	79.9	77.0	74.4	71.4
		3:20	TAS Kts.					329	327	322	316	307	295	279
-5	-42	(172)	IAS Kts.				225	223	220	217	212	206	199	187
		2:08	FF/Eng. #/hr.				1,180	1,140	1,080	1,030	970	900	830	730
		(105)	% RPM				88.5	85.7	83.6	81.3	78.8	76.0	73.4	70.6
		3:25	TAS Kts.				329	327	323	318	311	302	291	274
-10	-47	(182)	IAS Kts.			229	227	224	220	217	211	207	199	187
		2:05	FF/Eng. #/hr.			1,240	1,180	1,130	1,070	1,020	960	890	810	720
		(105)	% RPM			88.5	86.9	85.0	83.2	81.2	79.0	76.6	73.8	70.6
		3:28	TAS Kts.			331	328	324	319	314	307	299	288	271
-15	-52	(185)	IAS Kts.			230	227	224	221	217	211	206	199	188
		2:02	FF/Eng. #/hr.			1,230	1,170	1,120	1,060	1,000	950	880	810	700
		(105)	% RPM			88.5	86.3	84.3	82.5	80.6	78.5	76.2	73.4	70.5
		3:34	TAS Kts.			330	325	321	316	311	304	296	285	270
-20	-57	(187)	IAS Kts.			233	229	225	221	217	213	208	200	190
		2:00	FF/Eng. #/hr.			1,230	1,170	1,110	1,060	1,000	940	880	810	700
		(105)	% RPM			88.0	86.0	84.0	82.2	80.2	78.2	76.0	73.4	70.4
		3:34	TAS Kts.			329	324	319	314	309	303	295	284	270
-25	-57	(188)	IAS Kts.			231	228	225	221	217	213	208	200	190
		2:00	FF/Eng. #/hr.			1,230	1,170	1,110	1,060	1,000	940	880	810	700
		(105)	% RPM			88.0	86.0	84.0	82.0	80.0	78.0	76.0	73.4	70.4
		3:34	TAS Kts.			327	322	318	313	308	302	294	284	270
-30	-57	(188)	IAS Kts.			231	227	223	220	217	212	208	200	190
		2:00	FF/Eng. #/hr.			1,230	1,170	1,110	1,060	1,000	940	880	810	700
		(105)	% RPM			88.0	86.0	84.0	82.0	80.0	78.0	76.0	73.4	70.4
		3:34	TAS Kts.			326	321	316	311	307	301	294	284	270

INTERMEDIATE CRUISE FOUR ENGINES

ZFW 155,000 LB & LESS
Mno .62
ALT 28,000 FT

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-21	(125) 2:45 (105) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.								192 920 88.5 309	201 910 88.5 321	198 860 84.0 316	194 810 81.4 310
+15	-26	(132) 2:36 (105) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.								203 960 88.5 322	203 910 84.9 321	199 860 82.2 315	195 810 79.6 309
+10	-31	(140) 2:30 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.							203 990 88.5 320	207 970 85.7 325	203 910 82.9 318	199 850 60.1 312	194 800 77.6 305
+5	-36	(147) 2:24 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						204 1,030 88.5 317	212 1,030 86.7 329	208 960 83.4 323	204 900 80.6 316	199 840 78.0 308	194 780 75.4 300
Std.	-41	(154) 2:20 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						216 1,070 88.5 331	213 1,030 84.5 327	209 970 81.6 321	206 900 78.7 314	199 840 75.8 304	192 780 73.3 294
-5	-46	(162) 2:20 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					220 1,110 88.5 332	217 1,070 85.0 328	213 1,010 82.8 322	207 950 80.1 314	202 880 77.2 305	194 820 74.3 294	186 750 71.7 282
-10	-51	(170) 2:10 (105) 3:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					221 1,120 87.0 330	217 1,070 84.8 325	211 1,000 82.7 318	207 940 80.4 311	202 870 77.7 302	194 800 74.9 291	186 740 71.9 279
-15	-56	(175) 2:08 (105) 3:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				224 1,170 88.5 332	221 1,110 86.4 328	218 1,060 84.3 323	213 990 82.2 317	208 920 80.0 309	202 850 77.4 300	196 790 74.7 290	187 720 71.6 277
-20	-57	(175) 2:08 (105) 3:25	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				223 1,170 88.5 330	221 1,110 86.2 326	217 1,050 84.2 321	213 990 82.1 315	207 920 80.0 308	203 850 77.4 300	196 790 74.8 290	188 730 71.8 278
-25	-57	(175) 2:08 (105) 3:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				223 1,170 88.5 330	220 1,110 86.2 325	217 1,040 84.1 320	212 980 82.1 314	208 920 80.0 308	204 860 77.9 301	197 800 75.0 292	188 740 72.3 279
-30	-57	(175) 2:08 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				223 1,170 88.5 329	220 1,100 86.3 325	217 1,040 84.2 320	212 980 82.1 314	209 930 80.0 309	205 880 77.9 303	200 810 75.6 295	193 750 73.0 285

ZFW 155,000 LB & LESS
Mno .62
ALT 30,000 FT

INTERMEDIATE CRUISE FOUR ENGINES

°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	TIME HR. MIN.	GROSS WEIGHT (1000#) ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-25	(119) 3:03 (105) 3:07	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.									190 870 88.5 315	194 850 85.8 321	191 800 83.0 316
+15	-30	(125) 2:47 (105) 3:10	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.									200 900 88.5 326	195 840 83.6 319	191 790 80.9 313
+10	-35	(131) 2:38 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.								199 940 88.5 324	200 900 85.2 325	196 840 82.1 317	191 780 79.0 310
+5	-40	(134) 2:38 (105) 3:17	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.							199 970 88.5 320	205 970 86.3 330	202 900 82.9 323	196 840 79.6 314	190 760 76.3 305
Std.	-45	(146) 2:27 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.							209 1,010 87.8 332	206 950 83.8 327	203 890 81.0 321	198 830 77.9 313	188 750 74.7 299
-5	-50	(151) 2:24 (105) 3:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						211 1,050 88.5 331	209 1,010 85.5 328	205 950 82.8 322	201 890 80.0 315	196 810 77.0 306	186 720 74.0 292
-10	-55	(160) 2:17 (105) 3:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						214 1,060 87.3 331	210 1,000 85.1 326	206 940 82.8 320	201 880 80.3 312	194 800 77.6 302	187 710 74.6 290
-15	-57	(162) 2:16 (105) 3:34	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					214 1,090 88.5 330	214 1,050 86.8 330	209 990 84.5 324	205 930 82.3 318	202 870 79.9 310	195 790 77.2 301	187 700 74.2 289
-20	-57	(163) 2:18 (105) 3:34	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					214 1,090 88.5 330	213 1,050 86.5 329	209 990 84.2 323	205 930 82.0 317	201 870 79.7 310	195 790 77.1 301	187 700 74.2 289
-25	-57	(163) 2:18 (105) 3:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					213 1,090 88.5 329	211 1,050 86.5 327	208 990 84.2 323	204 930 82.0 316	200 860 79.7 309	195 800 77.2 301	188 710 74.4 291
-30	-57	(162) 2:18 (105) 3:23	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					212 1,090 88.5 328	212 1,050 86.8 328	209 990 84.5 323	205 930 82.2 317	201 870 79.8 310	196 810 77.5 303	190 740 75.0 293

NORMAL DESCENT PERFORMANCE

Descent at Mach number 0.62 or 250 knots EAS.

Flight idling power.

Minimum fuel flow.

All weights and temperatures.

Descent to 1,500 feet.

DESCENT ALT. (FT)		TIME (MIN)	FUEL (LB)	STILL AIR DISTANCE (N. MI.)	MEAN TAS (KNOTS)
FROM	TO				
30,000	1,500	15	410	76	304
28,000	1,500	14	390	70	300
26,000	1,500	13	370	64	295
24,000	1,500	12	350	58	290
22,000	1,500	11	330	53	289
20,000	1,500	10	310	48	288
18,000	1,500	9	280	43	287
16,000	1,500	8	260	38	285
14,000	1,500	7	230	33	283
12,000	1,500	6	200	28	280
10,000	1,500	5	160	23	276
8,000	1,500	4	130	18	270
6,000	1,500	3	90	13	260
4,000	1,500	2	50	8	240

PERFORMANCE AT 1.1 V L/D MAX FOUR ENGINES

PRESSURE ALTITUDE (FEET)	°C DEV. FROM STD. TEMP.	TRUE O.A.T. °C	GROSS WEIGHT (1000#) ⇨	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100	100 90
			IAS KTS ⇨	212	206	199	192	186	179	171	164	156
28,000'	+15	-26	% RPM FF/Eng. #/hr.					83.9 890	81.2 805	79.0 730	76.8 670	74.0 615
	Std	-41	% RPM FF/Eng. #/hr.			84.3 1,005	80.7 935	77.9 865	74.8 790	72.3 725	70.0 665	68.9 600
26,000'	+15	-22	% RPM FF/Eng. #/hr.				84.5 955	81.3 885	78.5 805	75.8 735	73.4 670	71.6 620
	Std	-37	% RPM FF/Eng. #/hr.		84.5 1,065	81.2 1,000	78.2 930	75.5 860	73.0 790	70.7 725	68.9 665	68.9 600
24,000'	+15	-18	% RPM FF/Eng. #/hr.			84.8 1,020	82.0 950	79.0 885	76.4 810	74.0 735	71.8 675	69.7 625
	Std	-33	% RPM FF/Eng. #/hr.	84.3 1,130	81.2 1,060	78.5 990	76.0 920	73.7 855	71.6 790	69.4 725	68.9 665	68.9 605
22,000'	+15	-14	% RPM FF/Eng. #/hr.		85.4 1,090	82.6 1,020	79.8 950	76.9 860	74.4 815	72.1 740	69.8 685	68.9 630
	Std	-29	% RPM FF/Eng. #/hr.	81.4 1,120	78.9 1,050	76.6 990	74.2 920	72.2 855	70.1 790	68.9 730	68.9 670	68.9 610
20,000'	+15	-10	% RPM FF/Eng. #/hr.	85.9 1,160	83.2 1,080	80.5 1,020	77.8 950	75.2 880	73.1 820	71.0 750	68.9 690	68.9 640
	Std	-25	% RPM FF/Eng. #/hr.	79.2 1,120	76.8 1,050	74.6 980	72.6 920	70.8 860	68.9 790	68.9 730	68.9 670	68.9 620
18,000'	+15	-6	% RPM FF/Eng #/hr.	83.7 1,150	81.0 1,080	78.4 1,020	76.0 960	73.8 890	71.4 820	69.7 760	68.9 700	68.9 650
	Std	-21	% RPM FF/Eng. #/hr.	77.4 1,120	75.1 1,050	73.1 980	71.1 920	69.8 860	68.9 800	68.9 740	68.9 680	68.9 630
16,000'	+15	-2	% RPM FF/Eng. #/hr.	81.3 1,150	79.0 1,090	76.6 1,020	74.4 960	72.4 890	70.5 830	68.9 770	68.9 710	68.9 660
	Std	-17	% RPM FF/Eng. #/hr.	75.5 1,120	73.8 1,050	71.8 990	70.2 930	68.9 870	68.9 810	68.9 750	68.9 690	68.9 640
14,000'	+15	+2	% RPM FF/Eng. #/hr.	79.5 1,150	77.1 1,090	75.0 1,030	73.1 970	71.0 900	68.9 840	68.9 780	68.9 730	68.9 670
	Std	-13	% RPM FF/Eng. #/hr.	74.0 1,120	72.3 1,050	70.8 1,000	68.9 930	68.9 870	68.9 810	68.9 760	68.9 710	68.9 650
12,000'	+15	+6	% RPM FF/Eng. #/hr.	77.8 1,160	75.6 1,090	73.7 1,030	71.6 970	70.1 910	68.9 850	68.9 790	68.9 740	68.9 680
	Std	-9	% RPM FF/Eng. #/hr.	72.6 1,120	71.3 1,060	69.8 1,000	68.9 940	68.9 880	68.9 820	68.9 770	68.9 720	68.9 670
10,000'	+15	+10	% RPM FF/Eng. #/hr.	76.1 1,160	74.3 1,100	72.5 1,050	70.9 990	68.9 930	68.9 860	68.9 810	68.9 750	68.9 700
	Std	-5	% RPM FF/Eng. #/hr.	71.6 1,130	70.2 1,060	68.9 1,010	68.9 950	68.9 890	68.9 840	68.9 780	68.9 730	68.9 690
1,500'	+15	+27	% RPM FF/Eng. #/hr.	71.6 1,220	70.3 1,160	68.9 1,100	68.9 1,040	68.9 980	68.9 930	68.9 880	68.9 830	68.9 780
	Std	+12	% RPM FF/Eng. #/hr.	68.9 1,180	68.9 1,120	68.9 1,070	68.9 1,010	68.9 960	68.9 910	68.9 860	68.9 820	68.9 780

FOUR ENGINE
OPERATION

DIVERSION PERFORMANCE

STANDARD
TEMPERATURE

Wind Comp. Kts.	N.M. to Alternate	40	80	120	160	200	240	280	320	360	400
-100	Alt. Ft.	8,100	14,500	19,500	23,000	25,000	25,000	25,000	25,000	25,000	25,000
	% RPM	68.9	72.0	75.2	78.5	80.9	80.6	80.5	80.4	80.3	80.3
	Fuel. lbs.	1,500	2,600	3,600	4,500	5,300	6,100	6,900	7,600	8,400	9,200
	Time Hr. Min.	0:19	0:35	0:49	1:01	1:13	1:25	1:36	1:48	2:00	2:12
-80	Alt. Ft.	6,900	12,800	17,800	21,300	24,000	25,000	25,000	25,000	25,000	25,000
	% RPM	68.9	70.9	74.0	76.8	78.6	80.8	80.6	80.4	80.4	80.3
	Fuel. lbs.	1,200	2,300	3,200	4,100	4,800	5,500	6,200	6,900	7,600	8,300
	Time Hr. Min.	0:16	0:30	0:44	0:55	1:05	1:16	1:26	1:37	1:48	1:59
-60	Alt. Ft.	6.200	11,600	16,200	19,800	22,600	24,600	25,000	25,000	25,000	25,000
	% RPM	68.9	70.2	73.0	75.5	78.0	80.4	80.8	80.5	80.4	80.4
	Fuel. lbs.	1,100	2,100	3,000	3,700	4,400	5,000	5,700	6,400	7,000	7,700
	Time Hr. Min.	0:14	0:27	0:39	0:50	1:00	1:09	1:18	1:28	1:38	1:49
-40	Alt. Ft.	5,600	10,500	14,900	18,500	21,400	23,600	25,000	25,000	25,000	25,000
	% RPM	68.9	69.6	72.2	74.5	76.8	79.1	80.9	80.6	80.5	80.4
	Fuel. lbs.	1,000	1,900	2,700	3,400	4,100	4,700	5,300	5,900	6,500	7,100
	Time Hr. Min.	0:13	0:24	0:36	0:46	0:55	1:04	1:12	1:21	1:30	1:40
-20	Alt. Ft.	5,000	9,600	13,700	17,300	20,200	22,500	24,400	25,000	25,000	25,000
	% RPM	68.9	69.0	71.5	73.6	75.8	77.9	80.0	80.8	80.6	80.5
	Fuel. lbs.	900	1,700	2,500	3,200	3,800	4,400	4,900	5,500	6,000	6,600
	Time Hr. Min.	0:11	0:22	0:33	0:42	0:51	1:00	1:07	1:15	1:24	1:32
0	Alt. Ft.	4,600	8,900	12,800	16,200	19,100	21,500	23,400	25,000	25,000	25,000
	% RPM	68.9	68.9	70.9	73.0	75.0	77.0	78.9	80.9	80.8	80.5
	Fuel. lbs.	800	1,600	2,300	2,900	3,500	4,100	4,600	5,100	5,700	6,200
	Time Hr. Min.	0:10	0:20	0:30	0:39	0:49	0:56	1:03	1:10	1:18	1:26
+20	Alt. Ft.	4,100	8,100	11,800	15,300	18,100	20,600	22,600	24,200	25,000	25,000
	% RPM	68.9	68.9	70.4	72.4	74.2	76.1	78.0	79.8	80.8	80.6
	Fuel. lbs.	800	1,500	2,100	2,800	3,300	3,900	4,400	4,900	5,400	5,900
	Time Hr. Min.	0:09	0:19	0:28	0:37	0:45	0:53	1:00	1:06	1:13	1:21
+40	Alt. Ft.	4,000	7,700	11,100	14,300	17,200	19,600	21,600	23,400	24,700	25,000
	% RPM	68.9	68.9	70.0	71.8	73.5	75.3	77.1	78.9	80.5	80.8
	Fuel. lbs.	700	1,400	2,000	2,600	3,100	3,600	4,100	4,600	5,000	5,600
	Time Hr. Min.	0:09	0:18	0:26	0:34	0:42	0:50	0:56	1:03	1:09	1:16
+60	Alt. Ft.	3,700	7,100	10,400	13,500	16,300	18,800	20,900	22,600	24,100	25,000
	% RPM	68.9	68.9	69.4	71.4	73.1	74.7	76.4	78.0	79.8	80.9
	Fuel. lbs.	700	1,300	1,900	2,400	3,000	3,500	4,000	4,400	4,800	5,300
	Time Hr. Min.	0:08	1:16	0:24	0:32	0:40	0:47	0:54	1:00	1:06	1:12
+80	Alt. Ft.	3,500	6,700	9,800	12,900	15,600	18,000	20,100	21,800	23,300	24,600
	% RPM	68.9	68.9	69.2	71.0	72.5	74.1	75.7	77.1	78.8	80.3
	Fuel. lbs.	600	1,200	1,800	2,300	2,800	3,300	3,800	4,200	4,600	5,000
	Time Hr. Min.	0:08	0:15	0:23	0:30	0:38	0:44	0:51	0:57	1:03	1:08

DIVERSION PERFORMANCE

CRUISE AT 25,000 FT. USING INTERMEDIATE CRUISE CHARTS

FOUR ENGINE OPERATION

INCLUDES CLIMB FROM SEA LEVEL AND DESCENT TO 1,500 FT.

STANDARD TEMPERATURE

Wind Comp. Kts.	N.M. to Alternate	450	500	550	600	650	700	750	800	850	
-100	Fuel. lbs.	10,300	11,300	12,400	13,300	14,100	15,100	16,200	17,100	18,200	
	Time Hr. Min.	2:18	2:33	2:47	3:01	3:13	3:27	3:42	3:56	4:11	
-80	Fuel. lbs.	9,400	10,400	11,300	12,200	13,000	13,900	14,800	15,700	16,600	
	Time Hr. Min.	2:06	2:19	2:33	2:46	2:58	3:09	3:22	3:35	3:48	
-60	Fuel. lbs.	8,700	9,600	10,400	11,200	12,000	12,800	13,600	14,400	15,100	
	Time Hr. Min.	1:56	2:08	2:20	2:31	2:43	2:54	3:05	3:17	3:27	
-40	Fuel. lbs.	8,100	8,900	9,700	10,400	11,200	12,000	12,700	13,500	14,200	
	Time Hr. Min.	1:48	1:59	2:10	2:20	2:30	2:43	2:52	3:03	3:14	
-20	Fuel. lbs.	7,600	8,300	9,000	9,800	10,400	11,200	11,900	12,600	13,300	
	Time Hr. Min.	1:40	1:50	2:00	2:11	2:20	2:30	2:41	2:52	3:00	
0	Fuel. lbs.	7,200	7,800	8,500	9,200	9,800	10,500	11,200	11,800	12,500	
	Time Hr. Min.	1:34	1:44	1:54	2:03	2:12	2:21	2:30	2:39	2:49	
+20	Fuel. lbs.	6,800	7,400	8,000	8,600	9,300	9,900	10,500	11,200	11,800	
	Time Hr. Min.	1:29	1:37	1:46	1:55	2:04	2:13	2:22	2:30	2:39	
+40	Fuel. lbs.	6,400	7,000	7,600	8,200	8,800	9,400	10,000	10,500	11,200	
	Time Hr. Min.	1:24	1:33	1:40	1:49	1:58	2:05	2:14	2:22	2:30	
+60	Fuel. lbs.	6,200	6,700	7,200	7,800	8,400	9,000	9,500	10,000	10,600	
	Time Hr. Min.	1:20	1:28	1:34	1:43	1:51	2:00	2:07	2:15	2:22	
+80	Fuel. lbs.	5,900	6,400	6,900	7,400	8,000	8,500	9,100	9,600	10,100	
	Time Hr. Min.	1:16	1:23	1:31	1:38	1:46	1:54	2:01	2:08	2:15	

SECTION 5

PART 3

1. Three Engine Climb

The three engine climb is conducted at 95.1% LP rpm (14,500).

The five tabular charts, Pages 3.2 to 3.6, are distinguished in terms of prevailing temperature anomaly, namely;

ISA
ISA + 5°C
ISA + 10°C
ISA + 15°C
ISA + 20°C

On each chart, as a function of take-off weight and pressure altitude, the following information is presented;

TAS, Average true airspeed, knots.
Fuel, Pounds of fuel consumed.
Time, Hours: Mins. elapsed.

In addition, the IAS airspeed is shown as a function of weight.

THREE ENGINE
OPERATION

CLIMB TABLE 95.1% LPRPM

STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT X 1000#		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE STD. TEMP. °C	IAS Knots	184	182	180	176	171	166	161	156	150	145	139	133
30000' - 45	TAS Kts. FUEL # TIME HR. Min.										201 2,900 0:40	190 2,300 0:31	180 1,900 0:25
28000' - 41	TAS Kts. FUEL # TIME HR. Min.									203 3,040 0:40	193 2,440 0:31	184 2,020 0:25	174 1,710 0:21
26000' - 37	TAS Kts. FUEL # TIME HR. Min.								205 3,150 0:40	196 2,520 0:31	186 2,100 0:26	178 1,790 0:22	169 1,510 0:18
24000' - 33	TAS Kts. FUEL # TIME HR. Min.							206 3,260 0:39	198 2,650 0:31	190 2,180 0:26	182 1,850 0:21	174 1,590 0:18	165 1,370 0:16
22000' - 29	TAS Kts. FUEL # TIME HR. Min.					216 4,360 0:52	208 3,270 0:38	200 2,670 0:31	192 2,210 0:25	184 1,880 0:21	176 1,620 0:18	169 1,410 0:16	161 1,230 0:14
20000' - 25	TAS Kts. FUEL # TIME HR. Min.				216 4,320 0:49	207 3.310 0:37	200 2,660 0:29	194 2,240 0:25	187 1,910 0:21	180 1,650 0:18	172 1,440 0:16	165 1,260 0:14	157 1,100 0:12
18000' - 21	TAS Kts. FUEL # TIME HR. Min.		220 4,950 0:55	216 4,240 0:46	209 3,270 0:36	202 2,650 0:28	196 2,250 0:24	189 1,910 0:20	182 1,650 0:17	176 1,440 0:15	168 1,260 0:13	161 1,110 0:12	153 970 0:10
16000' - 17	TAS Kts. FUEL # TIME HR. Min.	215 4,110 0:43	212 3.600 0:37	209 3,200 0:33	203 2,680 0:27	197 2,200 0:22	190 1,890 0:19	185 1,640 0:17	178 1,430 0:15	172 1,250 0:13	165 1,090 0:11	158 970 0:10	151 860 0:09
14000' - 13	TAS Kts. FUEL # TIME HR. Min.	209 3,070 0:31	206 2,770 0:28	203 2,520 0:25	197 2,130 0:21	192 1,820 0:18	186 1,560 0:16	180 1,370 0:14	174 1,200 0:12	168 1,070 0:11	161 940 0:09	155 840 0:08	148 750 0:07
12000' - 9	TAS Kts. FUEL # TIME HR. Min.	204 2,380 0:23	202 2,180 0:21	200 2,010 0:19	195 1,720 0:16	189 1,480 0:14	183 1,290 0:12	177 1,140 0:11	171 1,010 0:10	165 900 0:09	159 800 0:08	152 710 0:07	145 630 0:06
10000' - 5	TAS Kts. FUEL # TIME HR. Min.	200 1,840 0:17	198 1,700 0:16	195 1,560 0:15	190 1,360 0:13	185 1,190 0:11	180 1,040 0:10	174 930 0:09	168 830 0:08	162 740 0:07	156 650 0:06	150 590 0:05	143 520 0:05
8000' - 1	TAS Kts. FUEL # TIME HR. Min.												
6000' + 3	TAS Kts. FUEL # TIME HR. Min.												
4000' + 7	TAS Kts. FUEL # TIME HR. Min.												

THREE ENGINE
OPERATION

CLIMB TABLE 95.1% LPRPM

5°C
ABOVE
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT X 1000# ▷		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE STD. TEMP. °C	IAS Knots ▷	184	182	180	176	171	166	161	156	150	145	139	133
30000'	TAS Kts.										204	193	183
	FUEL #										3,250	2,470	1,990
- 45	TIME HR. Min.										0:45	0:34	0:27
28000'	TAS Kts.										195	186	176
	FUEL #										2,580	2,100	1,770
- 41	TIME HR. Min.										0:35	0:28	0:23
26000'	TAS Kts.								209	199	189	180	171
	FUEL #								3,580	2,740	2,240	1,850	1,580
- 37	TIME HR. Min.								0: 4	0:35	0:28	0:23	0:20
24000'	TAS Kts.								200	192	184	176	167
	FUEL #								2,860	2,320	1,950	1,640	1,400
- 33	TIME HR. Min.								0:35	0:28	0:23	0:20	0:17
22000'	TAS Kts.						210	202	194	186	178	171	163
	FUEL #						3,800	2,900	2,380	1,980	1,700	1,470	1,270
- 29	TIME HR. Min.						0:45	0:34	0:28	0:23	0:20	0:17	0:15
20000'	TAS Kts.						203	196	189	182	175	167	160
	FUEL #						2,950	2,440	2,030	1,740	1,500	1,300	1,130
- 25	TIME HR. Min.						0:34	0:27	0:23	0:20	0:17	0:14	0:12
18000'	TAS Kts.				211	204	198	191	184	177	170	163	155
	FUEL #				3,810	2,980	2,450	2,040	1,750	1,500	1,300	1,140	1,000
- 21	TIME HR. Min.				0:43	0:33	0: 2	0:22	0:19	0:16	0:14	0:12	0:11
16000'	TAS Kts.			211	205	199	1 9	187	180	174	167	160	153
	FUEL #			3,880	3,050	2,480	2,000	1,740	1,500	1,300	1,140	1,000	880
- 17	TIME HR. Min.			0:41	0:31	0:25	0:21	0:18	0:16	0:14	0:12	0:10	0:09
14000'	TAS Kts.	211	208	206	200	194	188	182	176	170	163	157	149
	FUEL #	3,460	3,150	2,850	2,400	2,000	1,690	1,450	1,250	1,100	970	850	760
- 13	TIME HR. Min.	0:37	0:34	0:30	0:25	0:21	0:18	0:15	0:13	0:11	0:10	0:09	0:08
12000'	TAS Kts.	207	204	202	196	190	185	179	173	167	160	153	146
	FUEL #	2,690	2,450	2,250	1,870	1,590	1,360	1,200	1,050	940	830	740	650
- 9	TIME HR. Min.	0:27	0:25	0:23	0:19	0:16	0:14	0:12	0:10	0:09	0:08	0:07	0:06
10000'	TAS Kts.	202	200	197	192	187	181	175	170	164	157	151	144
	FUEL #	2,100	1,920	1,750	1,480	1,260	1,100	970	860	760	680	610	530
- 5	TIME HR. Min.	0:21	0:19	0:17	0:15	0:13	0:11	0:09	0:08	0:07	0:06	0:06	0:05
8000'	TAS Kts.												
	FUEL #												
- 1	TIME HR. Min.												
6000'	TAS Kts.												
	FUEL #												
+ 3	TIME HR. Min.												
4000'	TAS Kts.												
	FUEL #												
+ 7	TIME HR. Min.												

THREE ENGINE
OPERATION

CLIMB TABLE 95.1% LPRPM

10°C
ABOVE
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT X 1000#		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE STD. TEMP. °C	IAS Knots	184	182	180	176	171	166	161	156	150	145	139	133
30000' - 45	TAS Kts. FUEL # TIME HR. Min.											197 2, 680 0:38	186 2, 100 0:30
28000' - 41	TAS Kts. FUEL # TIME HR. Min.										198 2, 710 0:41	188 2, 240 0:31	179 1, 850 0:25
26000' - 37	TAS Kts. FUEL # TIME HR. Min.									202 3, 010 0:41	192 2, 410 0:31	182 1, 950 0:25	173 1, 630 0:21
24000' - 33	TAS Kts. FUEL # TIME HR. Min.								202 3, 300 0:41	194 2, 520 0:32	186 2, 050 0:26	178 1, 720 0:21	170 1, 460 0:18
22000' - 29	TAS Kts. FUEL # TIME HR. Min.							205 3, 250 0:40	196 2, 600 0:32	188 2, 100 0:26	180 1, 790 0:22	173 1, 520 0:18	165 1, 310 0:16
20000' - 25	TAS Kts. FUEL # TIME HR. Min.						206 3, 450 0:39	199 2, 700 0:31	191 2, 200 0:26	184 1, 840 0:22	176 1, 560 0:18	169 1, 350 0:15	161 1, 160 0:13
18000' - 21	TAS Kts. FUEL # TIME HR. Min.					207 3, 460 0:39	200 2, 730 0:31	193 2, 240 0:26	186 1, 860 0:21	179 1, 590 0:18	172 1, 370 0:15	164 1, 180 0:13	157 1, 040 0:12
16000' - 17	TAS Kts. FUEL # TIME HR. Min.				207 3, 600 0:37	201 2, 800 0:29	195 2, 280 0:24	189 1, 900 0:21	182 1, 610 0:18	175 1, 380 0:15	168 1, 200 0:13	161 1, 040 0:11	154 910 0:10
14000' - 13	TAS Kts. FUEL # TIME HR. Min.			208 3, 380 0:37	202 2, 710 0:30	197 2, 210 0:24	190 1, 850 0:20	184 1, 570 0:17	178 1, 350 0:14	171 1, 160 0:12	165 1, 020 0:11	158 900 0:09	151 800 0:08
12000' - 9	TAS Kts. FUEL # TIME HR. Min.	209 3, 180 0:32	206 2, 880 0:30	204 2, 600 0:27	198 2, 120 0:22	192 1, 750 0:18	186 1, 490 0:15	180 1, 280 0:13	174 1, 110 0:11	168 970 0:10	161 850 0:09	154 750 0:08	148 660 0:07
10000' - 5	TAS Kts. FUEL # TIME HR. Min.	204 2, 460 0:25	201 2, 210 0:23	199 1,990 0:20	194 1, 650 0:17	188 1, 390 0:14	183 1, 190 0:12	177 1, 040 0:10	171 900 0:09	165 790 0:08	159 690 0:07	152 610 0:06	146 550 0:05
8000' - 1	TAS Kts. FUEL # TIME HR. Min.												
6000' + 3	TAS Kts. FUEL # TIME HR. Min.												
4000' + 7	TAS Kts. FUEL # TIME HR. Min.												

THREE ENGINE
OPERATION

CLIMB TABLE

95.1% LPRPM

15°C
ABOVE
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT X 1000#		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE STD. TEMP. °C	IAS Knots	184	182	180	176	171	166	161	156	150	145	139	133
30000' - 45	TAS Kts. FUEL # TIME HR. Min.											200 2, 920 0:44	188 2, 220 0:33
28000' - 41	TAS Kts. FUEL # TIME HR. Min.										203 3, 210 0:47	191 2, 410 0:34	181 1, 960 0:27
26000' - 37	TAS Kts. FUEL # TIME HR. Min.									205 3, 780 0:49	195 2, 630 0:36	185 2, 080 0:28	175 1, 720 0:23
24000' - 33	TAS Kts. FUEL # TIME HR. Min.								207 3, 730 0:50	197 2, 770 0:37	189 2, 230 0:29	180 1, 820 0:24	171 1, 550 0:20
22000' - 29	TAS Kts. FUEL # TIME HR. Min.							209 3, 960 0:51	200 2, 940 0:37	191 2, 320 0:29	183 1, 920 0:24	175 1, 610 0:20	167 1, 360 0:17
20000' - 25	TAS Kts. FUEL # TIME HR. Min.						210 4, 150 0:52	201 3, 060 0:38	194 2, 450 0:30	186 1, 990 0:24	179 1, 660 0:20	171 1, 410 0:17	164 1, 200 0:15
18000' - 21	TAS Kts. FUEL # TIME HR. Min.					210 4, 300 0:52	202 3, 150 0:37	195 2, 480 0:29	188 2, 020 0:24	181 1, 700 0:20	174 1, 440 0:17	166 1, 240 0:14	159 1, 060 0:12
16000' - 17	TAS Kts. FUEL # TIME HR. Min.				211 4, 400 0:51	203 3, 210 0:37	197 2, 560 0:28	191 2, 060 0:23	184 1, 720 0:20	177 1, 460 0:17	170 1, 250 0:14	163 1, 080 0:12	156 940 0:11
14000' - 13	TAS Kts. FUEL # TIME HR. Min.			212 4, 430 0:50	205 3, 150 0:35	199 2, 510 0:28	193 2, 060 0:22	186 1, 740 0:19	179 1, 450 0:16	173 1, 240 0:14	166 1, 060 0:12	160 930 0:10	153 810 0:09
12000' - 9	TAS Kts. FUEL # TIME HR. Min.	212 4, 370 0:47	209 3, 530 0:40	206 3, 120 0:34	200 2, 480 0:26	194 1, 980 0:21	188 1, 620 0:18	182 1, 390 0:15	176 1, 200 0:13	170 1,020 0:11	163 900 0:09	156 780 0:08	150 680 0:07
10000' - 5	TAS Kts. FUEL # TIME HR. Min.	206 3, 010 0:31	203 2, 600 0:27	201 2, 320 0:24	195 1, 910 0:19	190 1, 550 0:16	184 1, 300 0:14	179 1, 120 0:12	173 960 0:10	167 840 0:09	160 730 0:08	154 640 0:07	147 560 0:06
8000' - 1	TAS Kts. FUEL # TIME HR. Min.												
6000' + 3	TAS Kts. FUEL # TIME HR. Min.												
4000' + 7	TAS Kts. FUEL # TIME HR. Min.												

THREE ENGINE OPERATION

CLIMB TABLE 95.1% LPRPM

20° C
ABOVE
STANDARD
TEMPERATURE

TAKEOFF GROSS WEIGHT X 1000#		210	205	200	190	180	170	160	150	140	130	120	110
PRESSURE ALTITUDE STD. TEMP. °C	IAS Knots	184	182	180	176	171	166	161	156	150	145	139	133
30000' - 45	TAS Kts. FUEL # TIME HR. Min.												191 2,370 0:36
28000' - 41	TAS Kts. FUEL # TIME HR. Min.											194 2,670 0:39	184 2,110 0:29
26000' - 37	TAS Kts. FUEL # TIME HR. Min.										197 2,960 0:44	187 2,250 0:32	177 1,850 0:25
24000' - 33	TAS Kts. FUEL # TIME HR. Min.									201 3,160 0:43	191 2,450 0:33	182 1,970 0:26	173 1,630 0:21
22000' - 29	TAS Kts. FUEL # TIME HR. Min.								202 3,450 0:46	193 2,580 0:34	185 2,070 0:27	177 1,710 0:22	169 1,420 0:18
20000' - 25	TAS Kts. FUEL # TIME HR. Min.							204 3,850 0:47	196 2,770 0:34	188 2,180 0:27	180 1,770 0:22	173 1,490 0:19	165 1,260 0:16
18000' - 21	TAS Kts. FUEL # TIME HR. Min.							198 2,830 0:35	191 2,240 0:28	183 1,840 0:23	176 1,520 0:19	168 1,300 0:16	160 1,120 0:14
16000' - 17	TAS Kts. FUEL # TIME HR. Min.						200 2,960 0:33	193 2,300 0:27	186 1,890 0:22	179 1,570 0:18	172 1,330 0:15	165 1,130 0:13	157 980 0:11
14000' - 13	TAS Kts. FUEL # TIME HR. Min.					201 2,950 0:33	195 2,370 0:26	188 1,930 0:21	181 1,580 0:18	175 1,340 0:15	168 1,140 0:13	161 980 0:11	154 850 0:10
12000' - 9	TAS Kts. FUEL # TIME HR. Min.				202 2,900 0:32	196 2,270 0:24	190 1,860 0:20	184 1,520 0:17	177 1,300 0:14	171 1,100 0:12	165 960 0:10	158 820 0:09	151 720 0:08
10000' - 5	TAS Kts. FUEL # TIME HR. Min.		205 3,130 0:35	203 2,760 0:29	197 2,170 0:23	192 1,770 0:19	186 1,480 0:16	180 1,240 0:13	174 1,050 0:11	168 900 0:10	162 770 0:08	155 670 0:07	148 580 0:06
8000' - 1	TAS Kts. FUEL # TIME HR. Min.												
6000' + 3	TAS Kts. FUEL # TIME HR. Min.												
4000' + 7	TAS Kts. FUEL # TIME HR. Min.												

1A. Three Engine Cruise at 88.5% LP RPM (1164°K)

Three engine cruise at the intermediate power rating is flown at 88.5% (13,500) LP RPM and 1164°K prior to the V_{no} limit. For the range of temperatures and altitudes considered here (ISA - 15°C to ISA + 15°C and 10,000 to 30,000 feet respectively) the V_{no} limit may be encountered in the following areas:

At 15,000 feet and below for ISA - 15°C and at 11,000 feet and below for ISA conditions. There is no V_{no} limitation above 10,000 feet at ISA + 15°C.

This data may be used where enroute terrain clearances are not a problem, such as over-ocean flights. Where enroute clearances become limiting, operation at 95.1% LP RPM (Maximum Continuous Power) should be followed.

THREE ENGINE CRUISE 88.5% LP RPM (1164°K)

15°C BELOW
STANDARD TEMPERATURE
ZFW: 155,000 LB & LESS
EXCEPT AS NOTED

Alt. (ft)	True O.A.T. °C	Time Hr. Min.	G. W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
30,000'	-60	(125)	FF/Eng. #/Hr.									1,055	1,065	1,075
		3:10	TAS Kts.									295	306	315
		(105)	% RPM									88.5	88.5	88.5
		3:06	IAS Kts.									191	198	204
28,000'	-56	(135)	FF/Eng. #/Hr.								1,130	1,140	1,145	1,150
		2:57	TAS Kts.								292	303	312	318
		(105)	% RPM								88.5	88.5	88.5	88.5
		2:54	IAS Kts.								196	205	211	215
26,000'	-52	(145)	FF/Eng. #/Hr.							1,200	1,210	1,220	1,225	1,230
		2:47	TAS Kts.							289	300	308	315	321
		(105)	% RPM							88.5	88.5	88.5	88.5	88.5
		2:43	IAS Kts.							201	208	215	221	225
24,000'	-48	(155)	FF/Eng. #/Hr.						1,275	1,285	1,295	1,300	1,305	1,310
		2:37	TAS Kts.						288	298	306	312	318	322
		(105)	% RPM						88.5	88.5	88.5	88.5	88.5	88.5
		2:33	IAS Kts.						207	214	220	226	231	334
22,000'	-44	(165)	FF/Eng. #/Hr.					1,355	1,360	1,370	1,375	1,380	1,385	1,390
		2:27	TAS Kts.					284	295	303	310	315	319	323
		(105)	% RPM					88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:24	IAS Kts.					210	217	225	231	236	239	243
20,000'	-40	(175)	FF/Eng. #/Hr.				1,430	1,435	1,440	1,450	1,455	1,460	1,465	1,470
		2:20	TAS Kts.				282	292	301	307	312	316	320	321
		(105)	% RPM				88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:16	IAS Kts.				215	224	231	236	240	245	248	251
19,000'	-38	(185)	FF/Eng. #/Hr.			1,465	1,470	1,480	1,485	1,490	1,495	1,500	1,505	1,510
		2:16	TAS Kts.			275	287	295	302	308	313	317	320	323
		(105)	% RPM			88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:12	IAS Kts.			213	222	230	235	241	245	250	252	255
18,000'	-36	(185)	FF/Eng. #/Hr.			1,505	1,515	1,520	1,525	1,530	1,535	1,540	1,545	1,550
		2:13	TAS Kts.			281	290	298	304	309	313	317	320	323
		(105)	% RPM			88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:09	IAS Kts.			221	229	237	242	246	250	254	257	259
17,000'	-34	(195)	FF/Eng. #/Hr.		1,545	1,550	1,560	1,565	1,570	1,570	1,575	1,580	1,585	1,590
		2:09	TAS Kts.		274	285	293	300	305	310	314	317	320	322
		(105)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:06	IAS Kts.		220	229	236	242	247	251	254	258	261	262
16,000'	-32	(195)	FF/Eng. #/Hr.		1,585	1,595	1,600	1,605	1,610	1,615	1,615	1,620	1,625	1,625
		2.06	TAS Kts.		278	288	295	301	306	310	313	316	319	322
		(105)	% RPM		88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:03	IAS Kts.		226	235	242	247	252	255	258	261	263	266
15,000'	-30	(156)	FF/Eng. #/Hr.	1,620	1,630	1,640	1,645	1,645	1,650	1,615	(SEE FOLLOWING PAGE FOR Z.F.W OF 145,000 LB & LESS)			
		2:04	TAS Kts.	272	282	290	297	304	306	306				
		(145)	% RPM	88.5	88.5	88.5	88.5	88.5	88.4	87.5				
		2:05	IAS Kts.	225	233	240	247	254	255	255				
14,000'	-28	(168)	FF/Eng. #/Hr.	1,665	1,675	1,675	1,680	1,675	1,640	1,605	(SEE FOLLOWING PAGE FOR Z.F.W. OF 145,000 LB & LESS)			
		2:00	TAS Kts.	276	284	291	297	301	301	301				
		(145)	% RPM	88.5	88.5	88.5	88.5	88.1	87.2	86.4				
		2:05	IAS Kts.	231	239	245	250	255	255	255				
13,000'	-26	(180)	FF/Eng. #/Hr.	1,705	1,715	1,720	1,705	1,670	1,635	1,605	(SEE FOLLOWING PAGE FOR Z.F.W. OF 145,000 LB & LESS)			
		1:58	TAS Kts.	279	286	293	296	296	296	296				
		(145)	% RPM	88.5	88.5	88.5	88.0	87.1	86.3	85.6				
		2:05	IAS Kts.	238	245	251	255	255	255	255				
12,000'	-24	(190)	FF/Eng. #/Hr.	1,745	1,755	1,740	1,700	1,665	1,630	1,600	(SEE FOLLOWING PAGE FOR Z.F.W. OF 145,000 LB & LESS)			
		1:55	TAS Kts.	281	288	292	292	292	292	292				
		(145)	% RPM	88.5	88.5	88.1	87.1	86.2	85.4	84.7				
		2:05	IAS Kts.	244	250	254	255	255	255	255				
11,000'	-22	(200)	FF/Eng. #/Hr.	1,790	1,775	1,735	1,695	1,660	1,625	1,600	(SEE FOLLOWING PAGE FOR Z.F.W. OF 145,000 LB & LESS)			
		1:52	TAS Kts.	283	287	287	287	287	287	287				
		(145)	% RPM	88.5	88.0	87.1	86.2	85.3	84.6	83.9				
		2:05	IAS Kts.	249	253	253	254	254	254	254				
10,000'	-20	(205)	FF/Eng. #/Hr.	1,815	1,770	1,735	1,695	1,660	1,625	1,595	(SEE FOLLOWING PAGE FOR Z.F.W. OF 145,000 LB & LESS)			
		1:51	TAS Kts.	283	283	283	283	283	283	283				
		(145)	% RPM	88.2	87.2	86.3	85.4	84.6	83.9	83.1				
		2:05	IAS Kts.	253	253	253	253	253	253	253				

15°C BELOW
STANDARD TEMPERATURE
ZFW: 145,000 LB & LESS
EXCEPT AS NOTED

THREE ENGINE CRUISE 88.5% LP RPM (1164°K)

Alt. (ft)	True O.A.T. °C	Time Hr. Min.	G. W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
30,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
28,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
26,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
24,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
22,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
20,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
19,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
18,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
17,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
16,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
15,000'	-30	(205) 2:04 (105) 2:00	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,620 272 88.5 225	1,630 282 88.5 233	1,640 290 88.5 240	1,645 297 88.5 247	1,645 304 88.5 254	1,650 307 88.5 256	1,655 310 88.5 259	1,660 313 88.5 262	1,660 316 88.5 265	1,665 319 88.5 267	1,665 321 88.5 269
14,000'	-28	(205) 2:00 (105) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,665 276 88.5 231	1,675 284 88.5 239	1,675 291 88.5 245	1,680 297 88.5 250	1,685 302 88.5 256	1,690 306 88.5 259	1,695 310 88.5 262	1,700 313 88.5 265	1,700 316 88.5 269	1,705 318 88.5 271	1,705 320 88.5 273
13,000'	-26	(142) 1:58 (135) 1:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,705 279 88.5 238	1,715 286 88.5 245	1,720 293 88.5 251	1,725 298 88.5 256	1,725 303 88.5 261	1,730 306 88.5 264	1,740 310 88.5 267	1,710 311 87.8 268	(SEE FOLLOWING PAGE FOR Z.F.W. OF 135,000 LB & LESS)		
12,000'	-24	(157) 1:55 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,745 281 88.5 244	1,755 288 88.5 250	1,760 294 88.5 256	1,765 298 88.5 261	1,770 303 88.5 265	1,765 306 88.4 268	1,735 306 87.6 268	1,705 306 86.8 268	(SEE FOLLOWING PAGE FOR Z.F.W. OF 135,000 LB & LESS)		
11,000'	-22	(170) 1:52 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,790 283 88.5 249	1,795 289 88.5 255	1,800 294 88.5 260	1,805 298 88.5 264	1,790 301 88.2 268	1,760 301 87.5 268	1,730 301 86.7 268	1,700 301 86.0 268	(SEE FOLLOWING PAGE FOR Z.F.W. OF 135,000 LB & LESS)		
10,000'	-20	(182) 1:50 (135) 1:58	FF/Eng. #/Hr. TAS Kts. % RPM EAS Kts.	1,830 285 88.5 255	1,840 290 88.5 260	1,840 294 88.5 264	1,815 296 88.0 266	1,785 296 87.3 266	1,755 296 86.5 266	1,725 296 85.8 266	1,695 296 85.1 266	(SEE FOLLOWING PAGE FOR Z.F.W. OF 135,000 LB & LESS)		

THREE ENGINE CRUISE 88.5% LP RPM (1164°K)

15°C BELOW
STANDARD TEMPERATURE
ZFW: 135,000 LB & LESS

Alt. (ft)	True O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
30,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
28,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
26,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
24,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
22,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
20,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
19,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
18,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
17,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
16,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
15,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
14,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
13,000'	-26	(205) 1:58 (105) 1:55	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,705 279 88.5 238	1,715 286 88.5 245	1,720 293 88.5 251	1,725 298 88.5 256	1,725 303 88.5 261	1,730 306 88.5 264	1,735 310 88.5 267	1,740 313 88.5 270	1,740 315 88.5 272	1,745 317 88.5 274	1,750 319 88.5 276
12,000'	-24	(205) 1:55 (105) 1:52	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,745 281 88.5 244	1,755 288 88.5 250	1,760 294 88.5 256	1,765 298 88.5 261	1,770 303 88.5 265	1,770 306 88.5 268	1,775 309 88.5 270	1,780 312 88.5 273	1,780 315 88.5 277	1,785 317 88.5 279	1,785 319 88.5 280
11,000'	-22	(205) 1:52 (105) 1:50	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,790 283 88.5 249	1,795 289 88.5 255	1,800 294 88.5 260	1,805 298 88.5 264	1,810 302 88.5 268	1,815 306 88.5 272	1,815 309 88.5 274	1,820 311 88.5 276	1,820 313 88.5 279	1,825 316 88.5 282	1,825 319 88.5 284
10,000'	-20	(205) 1:50 (105) 1:48	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,830 285 88.5 255	1,840 290 88.5 260	1,840 294 88.5 264	1,845 298 88.5 268	1,850 302 88.5 272	1,855 305 88.5 275	1,855 308 88.5 278	1,860 311 88.5 281	1,860 313 88.5 283	1,865 315 88.5 285	1,865 317 88.5 287

THREE ENGINE CRUISE 88.5% LP RPM (1164°K)

STANDARD TEMPERATURE
ZFW: 145,000 LB & LESS

Alt. (ft)	True O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
30,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
28,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
26,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
24,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
22,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
20,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts											
19,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
18,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
17,000'			FF/Eng. #/Hr. TAS Kts % RPM IAS Kts.											
16,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
15,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
14,000'			FF/Eng. #/Hr. TAS Kts. % RPM IA S Kts.											
13,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
12,000'			FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.											
11,000'	-7	(205)	FF/Eng. #/Hr.	1,660	1,665	1,670	1,670	1,675	1,675	1,675	1,680	1,680	1,680	1,680
		2:01	TAS Kts.	264	273	280	286	291	295	298	301	304	307	309
		(105)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		1:59	IAS Kts.	224	232	239	246	250	254	257	260	263	265	267
10,000'	-5	(205)	FF/Eng. #/Hr.	1,700	1,705	1,705	1,710	1,710	1,715	1,715	1,720	1,720	1,720	1,725
		1:58	TAS Kts.	268	275	281	286	291	295	298	301	304	307	309
		(105)	% RPM	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		1:56	IAS Kts.	232	238	244	249	254	258	261	263	266	269	271

THREE ENGINE CRUISE 88.5% LP RPM (1164°K)

STANDARD TEMPERATU
ZFW: 155,000 LB & L
EXCEPT AS NOTE

Alt.	Temp. O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
30,000'	-45	(115) 3:22 (105) 3:21	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.										990 291 88.5 183	995 303 88.5 192
28,000'	-41	(125) 3:09 (105) 3:08	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.									1,055 286 88.5 187	1,060 298 88.5 195	1,065 308 88.5 201
26,000'	-37	(135) 2:59 (105) 2:57	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.								1,120 282 88.5 190	1,125 294 88.5 199	1,125 303 88.5 205	1,130 310 88.5 210
24,000'	-33	(145) 2:49 (105) 2:47	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.							1,185 278 88.5 193	1,190 291 88.5 202	1,195 299 88.5 209	1,200 307 88.5 215	1,200 312 88.5 218
22,000'	-29	(155) 2:40 (105) 2:38	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,255 275 88.5 198	1,255 287 88.5 207	1,260 296 88.5 214	1,265 303 88.5 220	1,270 309 88.5 224	1,270 313 88.5 227
20,000'	-25	(155) 2:30 (105) 2:29	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.						1,330 284 88.5 211	1,335 292 88.5 217	1,335 299 88.5 222	1,340 305 88.5 229	1,340 310 88.5 232	1,345 314 88.5 235
19,000'	-23	(165) 2:26 (105) 2:25	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,365 277 88.5 208	1,370 287 88.5 216	1,370 294 88.5 222	1,375 301 88.5 227	1,375 306 88.5 232	1,380 310 88.5 236	1,380 314 88.5 239
18,000'	-21	(165) 2:23 (105) 2:21	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.					1,400 281 88.5 216	1,405 289 88.5 222	1,410 296 88.5 227	1,415 302 88.5 233	1,415 306 88.5 237	1,415 310 88.5 240	1,420 313 88.5 242
17,000'	-19	(175) 2:19 (105) 2:17	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,435 274 88.5 213	1,440 283 88.5 221	1,445 291 88.5 227	1,445 297 88.5 231	1,450 302 88.5 235	1,450 306 88.5 240	1,450 310 88.5 243	1,455 313 88.5 246
16,000'	-17	(175) 2:16 (105) 2:14	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.				1,470 277 88.5 219	1,475 286 88.5 226	1,480 292 88.5 231	1,480 298 88.5 237	1,485 303 88.5 241	1,490 307 88.5 245	1,490 310 88.5 248	1,490 313 88.5 250
15,000'	-15	(185) 2:13 (105) 2:11	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,505 270 88.5 215	1,510 279 88.5 224	1,515 287 88.5 231	1,520 293 88.5 236	1,520 298 88.5 240	1,525 303 88.5 244	1,525 306 88.5 248	1,530 309 88.5 251	1,530 312 88.5 254
14,000'	-13	(185) 2:09 (105) 2:08	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.			1,545 273 88.5 222	1,550 281 88.5 230	1,555 288 88.5 236	1,555 294 88.5 241	1,560 299 88.5 245	1,560 303 88.5 249	1,565 306 88.5 252	1,565 309 88.5 255	1,565 312 88.5 257
13,000'	-11	(195) 2:07 (105) 2:05	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,580 267 88.5 220	1,585 276 88.5 228	1,590 283 88.5 235	1,595 289 88.5 241	1,595 294 88.5 245	1,600 299 88.5 250	1,600 303 88.5 253	1,605 306 88.5 256	1.605 309 88.5 259	1.605 311 88.5 261
12,000'	-9	(195) 2:03 (105) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.		1,625 270 88.5 227	1,625 278 88.5 234	1,630 285 88.5 241	1,635 290 88.5 245	1,635 295 88.5 250	1,640 299 88.5 253	1,640 302 88.5 256	1,640 305 88.5 259	1,645 308 88.5 262	1,645 310 88.5 264
11,000'	-7	(154) 2:01 (145) 2:02	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,660 264 88.5 224	1,665 273 88.5 232	1,670 280 88.5 239	1,670 286 88.5 246	1,675 291 88.5 250	1,675 295 88.5 254	1,640 296 86.4 255	(SEE FOLLOWING PAGE FOR Z.F.W. OF 145,000 LB & LESS)			
10,000'	-5	(164) 1:58 (145) 2:01	FF/Eng. #/Hr. TAS Kts. % RPM IAS Kts.	1,700 268 88.5 232	1,705 275 88.5 238	1,705 281 88.5 244	1,710 286 88.5 249	1,710 291 88.5 254	1,675 291 86.4 254	1,660 291 86.0 254	(SEE FOLLOWING PAGE FOR Z.F.W. OF 145,000 LB & LESS)			

THREE ENGINE CRUISE 88.5% LP RPM (1164°K)

15°C ABOVE
STANDARD TEMPERATURE
ZFW: 155,000 LB & LESS

Alt. (ft)	True O.A.T. °C	Time Hr. Min.	G.W. X 1000#	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
30,000'			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
28,000'			FF/Eng. #/Hr.											
			TAS Kts.											
			% RPM											
			IAS Kts.											
26,000'	-22	(115)	FF/Eng. #/Hr.										1,000	1,005
		3:20	TAS Kts.										278	290
		(105)	% RPM										88.5	88.5
		3:20	IAS Kts.										182	190
24,000'	-18	(125)	FF/Eng. #/Hr.									1,055	1,060	1,065
		3:09	TAS Kts.									272	285	294
		(105)	% RPM									88.5	88.5	88.5
		3:08	IAS Kts.									184	193	199
22,000'	-14	(135)	FF/Eng. #/Hr.								1,115	1,120	1,125	1,125
		2:59	TAS Kts.								266	279	288	295
		(105)	% RPM								88.5	88.5	88.5	88.5
		2:58	IAS Kts.								185	195	202	207
20,000'	-10	(145)	FF/Eng. #/Hr.							1,180	1,180	1,185	1,185	1,190
		2:50	TAS Kts.							261	274	283	290	296
		(105)	% RPM							88.5	88.5	88.5	88.5	88.5
		2:48	IAS Kts.							188	197	205	210	214
19,000'	-8	(145)	FF/Eng. #/Hr.							1,210	1,210	1,215	1,215	1,220
		2:45	TAS Kts.							265	276	284	291	296
		(105)	% RPM							88.5	88.5	88.5	88.5	88.5
		2:44	IAS Kts.							193	202	209	214	218
18,000'	-6	(145)	FF/Eng. #/Hr.							1,240	1,245	1,245	1,250	1,250
		2:41	TAS Kts.							268	278	285	291	296
		(105)	% RPM							88.5	88.5	88.5	88.5	88.5
		2:40	IAS Kts.							199	207	213	218	222
17,000'	-4	(155)	FF/Eng. #/Hr.						1,270	1,275	1,280	1,280	1,280	1,285
		2:38	TAS Kts.						260	270	279	286	291	296
		(105)	% RPM						88.5	88.5	88.5	88.5	88.5	88.5
		2:36	IAS Kts.						196	203	210	217	221	225
16,000'	-2	(155)	FF/Eng. #/Hr.						1,305	1,310	1,310	1,315	1,315	1,320
		2:33	TAS Kts.						263	273	280	286	291	295
		(105)	% RPM						88.5	88.5	88.5	88.5	88.5	88.5
		2:32	IAS Kts.						202	210	216	221	225	228
15,000'	0	(165)	FF/Eng. #/Hr.					1,335	1,340	1,345	1,345	1,350	1,350	1,350
		2:30	TAS Kts.					255	266	274	281	287	292	295
		(105)	% RPM					88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:28	IAS Kts.					198	207	214	220	226	230	232
14,000'	+2	(165)	FF/Eng. #/Hr.					1,370	1,370	1,375	1,380	1,380	1,380	1,385
		2:26	TAS Kts.					258	268	276	282	287	292	295
		(105)	% RPM					88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:24	IAS Kts.					204	213	219	224	229	233	236
13,000'	+4	(165)	FF/Eng. #/Hr.					1,405	1,410	1,410	1,415	1,415	1,415	1,420
		2:22	TAS Kts.					261	270	277	283	287	291	295
		(105)	% RPM					88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:20	IAS Kts.					210	217	223	228	233	236	239
12,000'	+6	(175)	FF/Eng. #/Hr.				1,435	1,440	1,445	1,445	1,450	1,450	1,455	1,455
		2:19	TAS Kts.				253	264	271	277	283	287	291	294
		(105)	% RPM				88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:17	IAS Kts.				206	216	222	227	232	237	240	242
11,000'	+8	(175)	FF/Eng. #/Hr.				1,475	1,480	1,480	1,485	1,485	1,490	1,490	1,495
		2:15	TAS Kts.				257	266	273	278	283	287	291	294
		(105)	% RPM				88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:14	IAS Kts.				213	221	227	231	236	241	244	246
10,000'	+10	(185)	FF/Eng. #/Hr.			1,510	1,515	1,520	1,525	1,525	1,525	1,530	1,530	1,530
		2:12	TAS Kts.			251	261	263	274	279	283	287	290	293
		(105)	% RPM			88.5	8 58	88.5	88.5	88.5	88.5	88.5	88.5	88.5
		2:11	IAS Kts.			211	220	227	232	236	240	244	247	250

2. Three Engine Cruise

The three engine cruise performance is flown at 95.1% LP rpm (14,500) to the 99% maximum range line, and thereafter at reduced throttle. These are presented in Pages 3.8 to 3.18.

This procedure is used when maintaining constant altitude, otherwise improved range is obtained by maintaining full rpm to a higher altitude.

The tables are presented for every 2,000 foot altitude between 10,000 feet and 30,000 feet.

Since there is no conflict with the V_{NO} speeds, each altitude table is applicable to all Zero Fuel Weights.

THREE ENGINE OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 10,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ▷	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+15	(195) 1:56 (105) 3:05	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		229 1,720 95.1 275	232 1,690 93.9 278	230 1,620 91.8 275	227 1,550 89.8 271	224 1,480 87.6 267	219 1,400 85.4 262	215 1,330 83.1 257	210 1,250 80.6 250	204 1,170 78.1 243	196 1,080 75.4 234
+15	+10	(205) 1:52 (105) 3.09	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.	232 1,780 95.1 275	236 1,750 94.1 280	235 1,690 92.0 279	233 1,620 90.0 276	231 1,540 88.0 272	225 1,470 85.6 266	221 1,390 83.2 261	214 1,310 81.1 254	210 1,230 78.7 248	203 1,150 76.0 240	196 1,060 73.5 231
+10	+5	(205) 1:49 (105) 3:13	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	237 1,830 94.5 283	240 1,750 92.3 281	237 1,690 90.2 279	236 1,620 88.1 276	231 1,540 85.8 271	226 1,460 83.5 265	221 1,380 81.3 259	215 1,300 78.9 252	208 1,210 76.4 244	202 1,130 74.0 236	194 1,040 71.7 227
+5	0	(205) 1:49 (105) 3:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,830 92.5 283	242 1,760 90.5 282	239 1,690 88.5 279	237 1,610 86.3 275	232 1,530 84.0 270	226 1,450 81.8 263	220 1,370 79.4 256	213 1,280 76.9 248	206 1,190 74.5 240	200 1,100 72.1 232	191 1,010 69.8 222
Std.	-5	(205) 1:49 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	248 1,830 90.7 286	246 1,760 88.8 283	242 1,690 86.7 279	238 1,610 84.5 274	233 1,520 82.3 268	226 1,440 80.0 261	219 1,350 77.5 253	212 1,260 75.0 245	205 1,170 72.5 236	196 1,070 70.2 226	185 980 68.9 213
-5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 12,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+11	(175) 2:02 (105) 3:08	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				226 1,640 93.1 279	223 1,540 91.1 275	220 1,460 89.2 271	218 1,390 87.2 268	213 1,310 84.5 262	208 1,230 81.9 256	202 1,150 79.1 248	194 1,060 76.1 238
+15	+6	(185) 2:01 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.			230 1,650 95.1 282	231 1,600 92.5 282	227 1,530 90.0 277	223 1,460 87.6 272	219 1,380 85.1 267	213 1,300 82.7 261	208 1,210 80.1 254	200 1,130 77.1 245	193 1,040 74.2 235
+10	+1	(191) 1:57 (105) 3:14	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		234 1,700 95.1 284	237 1,660 93.3 287	233 1,590 90.5 282	230 1,520 88.0 278	225 1,450 85.2 272	220 1,370 82.9 266	214 1,280 80.3 259	208 1,200 77.8 251	201 1,120 75.0 242	192 1,030 72.4 232
+ 5	-4	(195) 1:54 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		241 1,740 93.6 289	239 1,670 91.1 286	235 1,600 88.6 281	230 1,520 85.8 276	225 1,440 83.3 270	219 1,360 80.9 263	213 1,270 78.2 255	207 1,180 75.7 247	199 1,090 73.2 238	190 1,000 70.6 227
Std.	-9	(205) 1:50 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	243 1,810 93.2 288	241 1,740 90.8 286	239 1,670 88.5 283	236 1,590 86.1 279	232 1,510 84.1 275	226 1,430 81.8 268	219 1,340 79.1 260	212 1,250 76.4 252	205 1,160 73.9 243	198 1,070 71.6 234	189 980 69.4 223
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 14,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ▷	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+7	(165) 2:11 (105) 3:12	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					218 1,530 92.7 279	217 1,450 90.6 276	215 1,370 88.8 273	210 1,290 86.2 268	206 1,210 83.3 261	198 1,130 80.2 252	191 1,040 76.9 242
+15	+2	(175) 2:06 (105) 3:16	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.				227 1,580 95.1 287	227 1,520 92.0 286	221 1,450 89.3 278	217 1,370 86.7 273	212 1,290 84.0 267	207 1,200 81.2 260	200 1,120 78.2 251	191 1,020 75.1 240
+10	-3	(182) 2:03 (105) 3:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			230 1,620 95.1 288	231 1,570 92.5 288	227 1,510 89.8 283	224 1,430 87.2 278	218 1.360 84.6 272	212 1,280 82.0 265	207 1,190 79.2 257	199 1,100 76.3 248	190 1,010 73.4 237
+ 5	-8	(191) 1:57 (105) 3:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		235 1,700 95.1 291	236 1,650 93.2 292	233 1,580 90.5 287	228 1,510 87.7 282	223 1,430 85.1 276	218 1,350 82.6 270	211 1,260 80.0 262	205 1,180 77.2 253	198 1,080 74.4 244	188 990 71.7 232
Std.	-13	(205) 1:54 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	237 1,760 95.1 290	238 1,710 92.8 291	236 1,650 90.2 288	234 1,580 87.7 285	230 1,500 85.5 281	225 1,420 83.2 275	219 1,330 80.7 268	212 1,250 77.9 260	206 1,160 75.1 252	198 1,070 72.7 242	190 980 70.6 232
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 16,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ⇩	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	+3	(165) 2:16 (105) 3:16	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					215 1,470 95.1 282	216 1,440 93.0 284	213 1,360 90.3 280	208 1,280 87.8 274	204 1,200 84.8 268	198 1,110 81.6 259	189 1,020 78.2 248
+15	-2	(175) 2:11 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.				217 1,530 95.1 283	222 1,510 94.0 289	218 1,430 91.0 284	214 1,350 88.5 279	210 1,270 85.7 274	204 1,190 82.8 266	198 1,100 79.8 257	189 1,000 76.4 245
+10	-7	(175) 2:05 (105) 3:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			220 1,600 95.1 284	227 1,570 95.1 292	224 1,500 92.0 289	220 1,420 89.3 284	216 1,350 86.6 278	211 1,260 84.0 272	206 1,180 80.8 264	198 1,090 77.7 255	189 990 74.5 243
+ 5	-12	(185) 2:02 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			226 1,640 95.1 289	229 1,570 92.3 291	226 1,490 89.6 288	222 1,420 87.0 283	217 1,340 84.3 277	211 1,250 81.4 270	205 1,170 78.6 261	198 1,080 75.6 252	188 980 72.8 240
Std.	-17	(205) 1:58 (105) 3:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.	225 1,700 95.1 286	233 1,710 95.1 295	231 1,630 92.3 293	229 1,560 89.9 290	227 1,490 87.5 287	223 1,410 84.9 282	217 1,330 82.4 275	211 1,240 79.7 267	204 1,150 76.8 258	197 1,060 74.1 249	189 970 71.6 238
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 Kts EAS
ALT 18,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ▷	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-1	(155) 2:22 (105) 3:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						210 1,410 94.8 285	210 1,340 92.1 285	207 1,270 89.7 281	204 1,190 86.8 275	198 1,110 83.6 267	190 1,010 80.0 256
+15	-6	(165) 2:18 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.					213 1,450 95.1 286	214 1,410 93.0 288	212 1,330 90.2 285	208 1,260 88.0 280	204 1,190 84.9 274	198 1,100 81.6 265	189 1,000 77.9 253
+10	-11	(175) 2:12 (105) 3:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				216 1,510 95.1 287	220 1,490 94.0 292	217 1,410 91.2 288	213 1,330 88.6 284	210 1,260 85.7 279	205 1,180 82.6 272	198 1,090 79.3 262	187 990 75.8 249
+ 5	-16	(185) 2:08 (105) 3:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.			217 1,560 95.1 287	225 1,560 94.7 295	222 1,480 91.8 292	219 1,400 89.0 288	215 1,320 86.3 283	210 1,250 84.5 277	205 1,170 80.4 269	196 1,070 77.2 258	186 970 74.0 245
Std.	-21	(195) 2:04 (105) 3:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.		220 1,610 95.1 287	228 1,620 95.1 298	226 1,540 92.9 295	224 1,470 89.5 292	220 1,400 86.8 287	216 1,320 84.2 282	211 1,240 81.4 275	204 1,140 78.4 266	195 1,050 75.2 254	186 960 72.3 242
- 5			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW	155,000 LB & LESS
Vno	250 KTS EAS
ALT	20,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-5	(155) 2:32 (105) 3:18	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						199 1,320 95.1 279	205 1,320 93.6 288	202 1,230 91.1 283	199 1,160 88.5 278	195 1,090 85.2 273	190 1,010 81.8 265
+15	-10	(155) 2:26 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.						209 1,370 95.1 290	208 1,320 92.1 289	205 1,240 89.2 284	202 1,160 86.4 279	196 1,090 83.4 272	190 1,000 80.1 263
+10	-15	(165) 2:21 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					211 1,420 95.1 291	213 1,390 93.6 294	211 1,320 90.5 290	206 1,240 87.6 284	202 1,160 84.5 278	197 1,080 81.5 270	189 1,000 78.2 260
+ 5	-20	(175) 2:17 (105) 3:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				212 1,460 95.1 289	218 1,470 94.6 297	216 1,390 91.4 294	213 1,310 88.5 290	208 1,230 85.4 283	204 1,150 82.4 277	198 1,070 79.6 268	190 990 76.3 258
Std.	-25	(175) 2:11 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.				222 1,530 95.1 299	220 1,460 92.0 296	218 1,380 89.2 293	214 1,310 86.3 288	209 1,230 83.2 282	205 1,150 80.3 275	198 1,070 77.5 266	190 980 74.5 255
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW	155,000 LB
Vno	250 KTS EAS
ALT	22,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-9	(145) 2:39 (105) 3:20	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.							194 1, 260 95.1 282	199 1, 230 93.5 289	198 1, 160 90.5 286	194 1, 080 87.4 280	188 1, 000 83.7 271
+15	-14	(195) 2:35 (105) 3:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.							203 1, 290 94.5 291	202 1, 230 91.6 290	201 1, 160 88.7 287	196 1, 080 85.4 280	188 990 81.8 269
+10	-19	(156) 2:30 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						205 1, 340 95.1 291	207 1, 290 92.5 294	204 1, 220 89.5 290	202 1, 150 86.4 285	196 1, 070 83.2 277	188 980 79.8 267
+ 5	-24	(165) 2:24 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					206 1, 390 95.1 290	210 1, 360 92.7 295	209 1, 290 89.8 293	205 1, 210 87.1 288	202 1, 140 84.3 282	196 1, 060 81.2 275	190 980 77.9 266
Std.	-29	(165) 2:20 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.					214 1, 430 94.5 297	212 1, 350 91.0 294	209 1, 280 87.8 290	205 1, 200 84.8 285	202 1, 130 82.0 279	196 1, 050 79.0 272	191 980 76.1 264
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 15[illegible],000 LB & LESS
Vno 250 KTS EAS
ALT 24,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20	-13	(135) 2:48 (105) 3:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.								194 1,190 95.1 290	194 1,140 92.2 [illegible]	[illegible] 1,070 [illegible] [illegible]	187 990 [illegible] [illegible]
+15	-18	(135) 2:46 (105) 3:22	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.								200 1,210 94.5 295	196 1,140 90.4 270	192 [illegible] [illegible] 285	188 990 84.5 [illegible]
+10	-23	(145) 2:38 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.							200 1,270 95.1 293	201 1,220 92.1 294	198 1,140 88.5 289	[illegible] 1,060 85.5 283	188 980 82.6 276
+ 5	-28	(155) 2:32 (105) 3:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						200 1,310 95.1 291	205 1,290 92.6 298	203 1,210 89.8 294	199 1,130 86.7 288	194 1,050 83.2 [illegible]	[illegible] 970 79.7 [illegible]
Std.	-33	(155) 2:28 (105) 3:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.						208 1,350 94.8 299	207 1,270 90.8 297	204 1,200 87.6 293	200 1,120 84.5 287	194 1,050 81.2 279	188 970 79.7 270
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 26,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ▷	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+15	-22	(135) 2:54 (105) 3:24	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.								188 1,150 95.1 287	192 1,130 93.2 294	190 1,060 89.6 290	186 980 85.7 285
+10	-27	(135) 2:48 (105) 3:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.								195 1,190 94.8 295	194 1,120 91.2 293	191 1,050 87.6 289	187 970 83.7 283
+ 5	-32	(145) 2:43 (105) 3:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.							195 1,230 94.0 293	197 1,180 92.4 295	195 1,110 89.0 292	192 1,040 85.4 288	188 970 81.8 281
Std.	-37	(145) 2:43 (105) 3:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.							198 1,230 93.0 294	198 1,180 90.0 294	198 1,110 86.7 292	194 1,040 83.2 287	188 960 79.9 279
-5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 28,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ▷	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+15	-26	(125) 3:05 (105) 3:26	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.									183 1,080 95.1 290	186 1,040 92.2 295	183 970 88.4 290
+10	-31	(125) 3:04 (105) 3:28	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.									187 1,090 93.0 293	187 1,030 89.8 293	184 960 86.1 288
+ 5	-36	(125) 3:04 (105) 3:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.									188 1,090 91.2 292	187 1,020 87.6 290	184 950 84.0 286
Std.	-41	(135) 2:51 (105) 3:33	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.								194 1,170 93.5 297	192 1,090 89.0 293	188 1,010 84.9 288	185 940 81.8 283
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

THREE ENGINE
OPERATION

99% MAX RANGE CRUISE

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 30,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. MIN.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
+15	-30	(115) 3:20 (105) 3:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Knts.										177 1,000 94.2 290	178 950 90.3 292
+10	-35	(115) 3:20 (105) 3:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.										180 1,000 91.8 291	180 950 88.5 292
+ 5	-40	(115) 3:20 (105) 3:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.										184 1,000 89.8 295	182 950 86.5 292
Std.	-45	(125) 3:07 (105) 3:31	IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.									186 1,070 91.9 295	186 1,010 88.2 295	185 950 84.6 293
- 5			IAS Kts, FF/Eng. #/hr. % RPM TAS Kts.											
-10			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-15			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-20			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-25			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											
-30			IAS Kts. FF/Eng. #/hr. % RPM TAS Kts.											

3. Two-Engine Cruise

The two engine cruise performance is flown at 95.1% LP rpm (14,500). The altitudes shown are every 1,000 feet to 10,000 feet and thereafter every 2,000 feet to 20,000 feet.

The performance encounters the V_{NO} speed limit up to 5,000 feet, thereby requiring separate tables for the affected Zero Fuel Weight groups.

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 1,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+33	2:22	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,120 218 209	2,120 225 215	2,120 231 221	2,120 236 226	2,120 240 230	2,120 244 234	2,120 247 237	2,120 250 240
+15	+28	2:17	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,190 219 210	2,190 227 219	2,190 232 224	2,190 237 228	2,190 242 233	2,190 246 237	2,190 249 241	2,190 252 244	2,190 254 246
+10	+23	2:13	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,260 220 212	2,260 228 220	2,260 234 227	2,260 239 232	2,260 243 236	2,260 247 240	2,260 250 243	2,260 253 247	2,260 256 250	2,260 258 252
+ 5	+18	2:09	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,330 228 223	2,330 234 229	2,330 239 235	2,330 244 240	2,330 248 244	2,330 251 247	2,330 254 250			
Std.	+13	2:06	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.	2,390 228 225	2,390 234 231	2,390 240 237	2,390 245 243	2,390 249 247	2,390 252 250					
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 2,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+31	2:25	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,070 216 203	2,070 223 210	2,070 230 217	2,070 235 222	2,070 240 227	2,070 244 231	2,070 247 234	2,070 250 237
+15	+26	2:20	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,140 225 213	2,140 232 220	2,140 237 225	2,140 242 230	2,140 246 234	2,140 249 238	2,140 252 241	2,140 255 244
+10	+21	2:16	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,210 226 216	2,210 233 223	2,210 238 228	2,210 243 233	2,210 247 237	2,210 251 241	2,210 254 245	2,210 257 248	2,210 259 250
+ 5	+16	2:12	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,280 228 219	2,280 234 225	2,280 239 231	2,280 244 236	2,280 248 240	2,280 252 244	2,280 255 247	2,280 258 251		
Std.	+11	2:08	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.	2,350 227 220	2,350 234 227	2,350 240 233	2,350 245 239	2,350 250 245	2,350 253 248	2,350 257 252				
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW	155,000 L
Vno	250 KTS EA
ALT	3,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+29	2:29	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					2,020 222 205	2,020 229 211	2,020 235 218	2,020 240 223	2,020 244 227	2,020 248 231	2,020 251 234
+15	+24	2:24	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,090 224 209	2,090 231 216	2,090 236 221	2,090 241 225	2,090 246 230	2,090 250 235	2,090 253 238	2,090 255 240
+10	+19	2:19	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,160 225 212	2,160 232 219	2,160 238 225	2,160 243 230	2,160 247 234	2,160 251 238	2,160 254 242	2,160 257 244	2,160 260 247
+ 5	+14	2:14	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,240 225 213	2,240 232 220	2,240 239 228	2,240 244 233	2,240 249 238	2,240 252 241	2,240 256 245	2,240 259 248	2,240 261 250	2,240 264 254
Std.	+9	2:10	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,310 232 222	2,310 239 229	2,310 245 236	2,310 250 241	2,310 254 245	2,310 257 248	2,310 260 251			
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW 155,000 LB
Vno 250 KTS EAS
ALT 4,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+27	2:32	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,970 220 201	1,970 228 208	1,970 235 215	1,970 240 219	1,970 244 224	1,970 248 228	1,970 251 231
+15	+22	2:27	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,040 221 203	2,040 229 210	2,040 236 217	2,040 241 222	2,040 246 227	2,040 250 232	2,040 253 234	2,040 256 238
+10	+17	2:22	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,110 230 214	2,110 237 221	2,110 243 227	2,110 247 231	2,110 251 235	2,110 255 239	2,110 258 242	2,110 [illegible] 244
+ 5	+12	2:17	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,190 231 216	2,190 238 223	2,190 244 229	2,190 249 234	2,190 253 238	2,190 256 241	2,190 260 246	2,190 262 248	2,190 265 251
Std.	+7	2:12	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,270 231 218	2,270 238 224	2,270 245 233	2,270 250 237	2,270 254 241	2,270 258 245	2,270 261 248	2,270 264 252		
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW	155,000 LB
Vno	250 KTS EAS
ALT	5,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+25	2.36	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1,920 226 203	1,920 234 211	1,920 240 216	1,920 244 221	1,920 248 226	1,920 251 228
+15	+20	2:31	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,990 227 206	1,990 235 213	1,990 241 219	1,990 246 224	1,990 250 228	1,990 253 231	1,990 256 234
+10	+15	2.25	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,070 228 209	2,070 236 217	2,070 242 222	2,070 247 227	2,070 251 231	2,070 255 235	2,070 258 238	2,070 261 241
+5	+10	2:20	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,140 229 211	2,140 237 219	2,140 243 225	2,140 248 229	2,140 253 234	2,140 257 238	2,140 260 242	2,140 263 245	2,140 265 247
Std.	+5	2:15	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,220 229 213	2,220 237 220	2,220 244 228	2,220 250 233	2,220 254 237	2,220 258 241	2,220 262 245	2,220 265 249	2,220 267 251	
-5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

ZFW	155,000 LB & LESS
Vno	250 KTS EAS
ALT	6,000 FT

TWO ENGINE
OPERATION

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+23	2:40	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1,880 225 199	1,880 233 206	1,880 239 212	1,880 244 217	1,880 248 221	1,880 252 225
+15	+18	2:35	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,940 226 202	1,940 234 209	1,940 240 215	1,940 245 219	1,940 250 225	1,940 254 228	1,940 257 231
+10	+13	2:29	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,010 226 204	2,010 235 212	2,010 241 218	2,010 247 224	2,010 251 228	2,010 255 232	2,010 259 236	2,010 261 238
+ 5	+8	2:24	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,090 236 215	2,090 242 220	2,090 248 226	2,090 253 231	2,090 257 235	2,090 260 239	2,090 263 242	2,090 266 244
Std.	+3	2:18	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,170 235 215	2,170 243 223	2,170 249 229	2,170 254 234	2,170 258 238	2,170 262 242	2,170 265 246	2,170 268 248	2,170 270 250
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

Z.F.W. 155,000 LB & LESS
Vno 250 KTS EAS
ALT 7,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+21	2:44	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1,830 222 194	1,830 231 202	1,830 238 209	1,830 244 214	1,830 248 218	1,830 252 222
+15	+16	2:38	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,900 224 198	1,900 232 204	1,900 239 210	1,900 245 216	1,900 250 222	1,900 254 225	1,900 257 228
+10	+11	2:33	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,960 233 207	1,960 240 214	1,960 246 219	1,960 251 224	1,960 255 228	1,960 259 232	1,960 262 235
+ 5	+6	2:27	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,040 234 210	2,040 241 216	2,040 247 222	2,040 252 226	2,040 257 231	2,040 261 236	2,040 264 238	2,040 266 240
Std.	+1	2:22	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,120 232 210	2,120 241 219	2,120 248 225	2,120 253 229	2,120 258 234	2,120 262 238	2,120 265 242	2,120 268 245	2,120 271 248
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE -
OPERATION

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 8,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+19	2:49	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.							1,780 229 197	1,780 237 204	1,780 243 210	1,780 248 214	1,780 252 218
+15	+14	2:42	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1,850 230 199	1,850 238 207	1,850 244 212	1,850 249 217	1,850 254 222	1,850 257 225
+10	+9	2:37	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,910 231 202	1,910 239 209	1,910 245 215	1,910 250 219	1,910 255 225	1,910 259 228	1,910 262 231
+ 5	+4	2:31	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				1,990 230 203	1,990 239 211	1,990 246 218	1,990 251 222	1,990 256 227	1,990 260 232	1,990 264 235	1,990 267 238
Std.	-1	2:25	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,070 238 213	2,070 246 220	2,070 252 225	2,070 257 230	2,070 262 235	2,070 266 239	2,070 269 242	2,070 271 244
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 9,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+17	2:53	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.							1,730 227 192	1,730 236 200	1,730 243 206	1,730 248 211	1,730 252 214
+15	+12	2:46	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1,800 227 194	1,800 236 202	1,800 243 208	1,800 249 214	1,800 254 218	1,800 257 221
+10	+7	2:40	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,870 227 [illegible]	1,870 236 203	1,870 243 210	1,870 250 216	1,870 255 221	1,870 259 225	1,870 262 228
+5	+2	2:34	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,940 237 206	1,940 244 212	1,940 250 218	1,940 256 223	1,940 260 228	1,940 264 232	1,940 267 234
Std.	-3	2:29	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,020 235 207	2,020 244 215	2,020 251 221	2,020 257 226	2,020 261 230	2,020 265 235	2,020 269 238	2,020 272 241
-5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW	155,000 LB & LESS
Vno	250 KTS EAS
ALT	10,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+15	2:57	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.							1,690 222 185	1,690 234 195	1,690 242 202	1,690 248 208	1,690 252 212
+15	+10	2:50	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.							1,760 233 196	1,760 242 204	1,760 249 211	1,760 254 215	1,760 257 219
+10	+5	2:45	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1,820 233 198	1,820 242 205	1,820 249 212	1,820 254 217	1,820 259 222	1,820 262 224
+ 5	0	2:39	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,890 231 198	1,890 242 207	1,890 249 213	1,890 255 219	1,890 260 224	1,890 264 228	1,890 267 230
Std.	-5	2:33	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,960 241 209	1,960 249 215	1,960 256 221	1,960 261 227	1,960 265 231	1,960 269 235	1,960 272 237
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

GW	155,000 LB & LESS
Vmo	250 KTS EAS
ALT	12,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+11	3:05	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.								1, 620 229 185	1, 620 239 194	1, 620 247 201	1, 620 252 205
+15	+6	2:59	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.							1, 680 227 185	1, 680 238 194	1, 680 246 201	1, 680 253 207	1, 680 257 211
+10	+1	2:52	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.							1, 740 238 197	1, 740 246 203	1, 740 253 210	1, 740 258 214	1, 740 263 218
+ 5	-4	2:46	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1, 810 237 197	1, 810 246 205	1, 810 253 211	1, 810 259 217	1, 810 264 221	1, 810 268 224
Std.	-9	2:39	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1, 880 245 206	1, 880 253 213	1, 880 260 219	1, 880 265 224	1, 880 269 227	1, 880 272 230
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW 155,000 LB & LESS
Vno 250 KTS EAS
ALT 14,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
+20	+7	3:16	FF/Eng. #/Hr.									1, 530	1, 530	1, 530
			TAS Kts.									235	244	251
			or % RPM											
			IAS Kts.									185	192	198
+15	+2	3:09	FF/Eng. #/Hr.								1, 590	1, 590	1, 590	1, 590
			TAS Kts.								233	243	251	257
			or % RPM											
			IAS Kts.								185	193	199	204
+10	-3	3:03	FF/Eng. #/Hr.								1, 640	1, 640	1, 640	1, 640
			TAS Kts.								242	250	257	262
			or % RPM											
			IAS Kts.								193	200	[illegible]	210
+ 5	-8	2:55	FF/Eng. #/Hr.							1, 710	1, 710	1, 710	1, 710	1, 710
			TAS Kts.							241	250	257	263	267
			or % RPM											
			IAS Kts.							194	201	208	213	218
Std.	-13	2:49	FF/Eng. #/Hr.						1, 770	1, 770	1, 770	1, 770	1, 770	1, 770
			TAS Kts.						237	248	257	263	268	272
			or % RPM											
			IAS Kts.						193	202	209	215	220	224
- 5			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-10			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-15			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-20			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-25			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-30			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATORS

ZFW	155,000 LB & LESS
Vno	250 KTS EAS
ALT	16,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+3	3:25	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.									1,460 228 174	1,460 240 183	1,460 249 190
+15	-2	3:18	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.									1,510 238 184	1,510 248 191	1,510 256 197
+10	-7	3:11	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.								1,570 235 182	1,570 246 191	1,570 255 198	1,570 261 203
+ 5	-12	3:04	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.								1,630 245 191	1,630 254 199	1,630 261 205	1,630 267 210
Std.	-17	2:58	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.							1,690 241 190	1,690 252 199	1,690 260 206	1,690 266 211	1,690 271 215
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW	155,000 LB & LESS
Vno	250 KTS EAS
ALT	18,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
+20	-1	3:37	FF/Eng. #/Hr.										1,380	1,380
			TAS Kts.										234	246
			or % RPM											
			IAS Kts.										174	182
+15	-6	3:30	FF/Eng. #/Hr.										1,430	1,430
			TAS Kts.										244	253
			or % RPM											
			IAS Kts.										182	189
+10	-11	3:21	FF/Eng. #/Hr.									1,490	1,490	1,490
			TAS Kts.									240	251	259
			or % RPM											
			IAS Kts.									181	189	195
+ 5	-16	3:15	FF/Eng. #/Hr.									1,540	1,540	1,540
			TAS Kts.									249	258	265
			or % RPM											
			IAS Kts.									189	196	202
Std.	-21	3:08	FF/Eng. #/Hr.								1,600	1,600	1,600	1,600
			TAS Kts.								246	256	264	270
			or % RPM											
			IAS Kts.								189	197	203	208
- 5			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-10			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-15			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-20			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-25			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-30			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW	155,000 LB & LESS
Vno	250 KTS EAS
ALT	20,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000#	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	-5	3:51	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											1, 300 242 174
+15	-10	3:42	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.										1, 350 237 172	1, 350 249 180
+10	-15	3:34	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.										1, 400 246 180	1, 400 256 187
+ 5	-20	3:25	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.									1, 460 241 178	1, 460 253 186	1, 460 262 193
Std.	-25	3:19	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.									1, 510 249 185	1, 510 259 192	1, 510 267 198
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

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HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW 145,000 LB & LESS
Vno 262 KTS IAS
ALT 1,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+33	2:22	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,120 218 209	2,120 225 215	2,120 231 221	2,120 236 226	2,120 240 230	2,120 244 234	2,120 247 237	2,120 250 240
+15	+28	2:17	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,190 219 210	2,190 227 219	2,190 232 224	2,190 237 228	2,190 242 233	2,190 246 237	2,190 249 241	2,190 252 244	2,190 254 246
+10	+23	2:13	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,260 220 212	2,260 228 220	2,260 234 227	2,260 239 232	2,260 243 236	2,260 247 240	2,260 250 243	2,260 253 247	2,260 256 250	2,260 258 252
+ 5	+18	2:09	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,330 228 223	2,330 234 229	2,330 239 235	2,330 244 240	2,330 248 244	2,330 251 247	2,330 254 250	2,330 257 254	2,330 259 256	2,330 261 258
Std.	+13	2:06	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.	2,390 228 225	2,390 234 231	2,390 240 237	2,390 245 243	2,390 249 247	2,390 252 250	2,390 255 254	2,390 258 257	2,390 261 260	2,390 263 263	2,390 265 265
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW	145,000 LB & LESS
Vno	262 KTS EAS
ALT	2,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
+25			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
+20	+31	2:25	FF/Eng. #/Hr.				2,070	2,070	2,070	2,070	2,070	2,070	2,070	2,070
			TAS Kts.				216	223	230	235	240	244	247	250
			or % RPM											
			IAS Kts.				203	210	217	222	227	231	234	237
+15	+26	2:20	FF/Eng. #/Hr.				2,140	2,140	2,140	2,140	2,140	2,140	2,140	2,140
			TAS Kts.				225	232	237	242	246	249	252	255
			or % RPM											
			IAS Kts.				213	220	225	230	234	238	241	244
+10	+21	2:16	FF/Eng. #/Hr.			2,210	2,210	2,210	2,210	2,210	2,210	2,210	2,210	2,210
			TAS Kts.			226	233	238	243	247	251	254	257	259
			or % RPM											
			IAS Kts.			216	223	228	233	237	241	245	248	250
+5	+16	2:12	FF/Eng. #/Hr.		2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280
			TAS Kts.		228	234	239	244	248	252	255	258	261	263
			or % RPM											
			IAS Kts.		219	225	231	236	240	244	247	251	254	256
Std.	+11	2:08	FF/Eng. #/Hr.	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350
			TAS Kts.	227	234	240	245	250	253	257	260	262	264	266
			or % RPM											
			IAS Kts.	220	227	233	239	245	248	252	255	258	260	262
-5			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-10			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-15			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-20			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-25			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											
-30			FF/Eng. #/Hr.											
			TAS Kts.											
			or % RPM											
			IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW	145,000 LB & LESS
Vno	262 KTS EAS
ALT	3,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+29	2:29	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					2,020 222 205	2,020 229 211	2,020 235 218	2,020 240 223	2,020 244 227	2,020 248 231	2,020 251 234
+15	+24	2:24	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,090 224 209	2,090 231 216	2,090 236 221	2,090 241 225	2,090 246 230	2,090 250 235	2,090 253 238	2,090 255 240
+10	+19	2:19	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,160 225 212	2,160 232 219	2,160 238 225	2,160 243 230	2,160 247 234	2,160 251 238	2,160 254 242	2,160 257 244	2,160 260 247
+ 5	+14	2:14	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,240 225 213	2,240 232 220	2,240 239 228	2,240 244 233	2,240 249 238	2,240 252 241	2,240 256 245	2,240 259 248	2,240 261 250	2,240 264 254
Std.	+9	2:10	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,310 232 222	2,310 239 229	2,310 245 236	2,310 250 241	2,310 254 245	2,310 257 248	2,310 260 251	2,310 263 255	2,310 265 257	2,310 267 259
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

TWO ENGINE
OPERATION

ZFW 145,000 LB & LESS
Vno 262 KTS EAS
ALT 4,000 FT

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+27	2:32	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,970 220 201	1,970 228 208	1,970 235 215	1,970 240 219	1,970 244 224	1,970 248 228	1,970 251 231
+15	+22	2:27	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,040 221 203	2,040 229 210	2,040 236 217	2,040 241 222	2,040 246 227	2,040 250 232	2,040 253 234	2,040 256 238
+10	+17	2:22	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,110 230 214	2,110 237 221	2,110 243 227	2,110 247 231	2,110 251 235	2,110 255 239	2,110 258 242	2,110 260 244
+ 5	+12	2:17	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,190 231 216	2,190 238 223	2,190 244 229	2,190 249 234	2,190 253 238	2,190 256 241	2,190 260 246	2,190 262 248	2,190 265 251
Std.	+7	2:12	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,270 231 218	2,270 238 224	2,270 245 233	2,270 250 237	2,270 254 241	2,270 258 245	2,270 261 248	2,270 264 252	2,270 266 254	2,270 269 257
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

HIGH SPEED CRUISE 95.1% LPRPM
CONSTANT FLIGHT LEVEL

ZFW 145,000 LB & LESS
Vnc 262 KTS EAS
ALT 5,000 FT

TWO ENGINE
OPERATION

°C Dev. from Std. Temp.	O.A.T. °C	Time Hr. Min.	G.W. X 1000# ⇨	210 200	200 190	190 180	180 170	170 160	160 150	150 140	140 130	130 120	120 110	110 100
+30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
+20	+25	2:36	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.						1,920 226 203	1,920 234 211	1,920 240 216	1,920 244 221	1,920 248 226	1,920 251 228
+15	+20	2:31	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.					1,990 227 206	1,990 235 213	1,990 241 219	1,990 246 224	1,990 250 228	1,990 253 231	1,990 256 234
+10	+15	2:25	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.				2,070 228 209	2,070 236 217	2,070 242 222	2,070 247 227	2,070 251 231	2,070 255 235	2,070 258 238	2,070 261 241
+ 5	+10	2:20	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.			2,140 229 211	2,140 237 219	2,140 243 225	2,140 248 229	2,140 253 234	2,140 257 238	2,140 260 242	2,140 263 245	2,140 265 247
Std.	+5	2:15	FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.		2,220 229 213	2,220 237 220	2,220 244 228	2,220 250 233	2,220 254 237	2,220 258 241	2,220 262 245	2,220 265 249	2,220 267 251	2,220 270 253
- 5			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-10			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-15			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-20			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-25			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											
-30			FF/Eng. #/Hr. TAS Kts. or % RPM IAS Kts.											

4. Drift Down, Three Engines

The three engine drift-down data is presented on Pages 3.41 to 3.51.

Assuming engine failure to occur while cruising at altitude, the data indicates the quantity of fuel consumed, the still air distance traversed, the Average True Air Speed during drift down, and the altitude at which the C.A.R. required climb gradient will be maintained at the final weight.

Each page relates to a specific altitude at which engine failure is assumed to occur, and a table is thereby shown for every 2,000 foot altitude, between 10,000 feet and 30,000 feet.

For use in evaluating the terrain clearance, the drift-down path with three engines operating at 95.1% LP rpm is given in Figures 3-2 to 3-5.

ENGINE FAILURE AT
ALT. 10,000 FT.

DRIFT DOWN

THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166				
+30	Alt. FT.		4,500	6,700	8,810				
	Time Hr. Min.		1:03	53	37				
	Fuel, lbs.		5,500	4,370	2,850				
	TAS Kts.		199	200	202				
+20	Alt. FT.	6,000	7,910	9,700					
	Time Hr. Min.	56	45	23					
	Fuel, lbs.	5,100	3,870	1,830					
	TAS Kts.	204	206	205					
+10	Alt. FT.	9,100							
	Time Hr. Min.	32							
	Fuel, lbs.	2,920							
	TAS Kts.	211							
ISA	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 12,000 FT.

DRIFT DOWN

THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161			
+30	Alt. FT.			6,850	9,060	11,140			
	Time Hr. Min.			1:01	50	31			
	Fuel, lbs.			4,950	3,850	2,330			
	TAS Kts.			202	203	204			
+20	Alt. FT.	6,100	8,100	10,100	11,870				
	Time Hr. Min.	1:03	55	44	17				
	Fuel, lbs.	5,600	4,680	3,530	1,330				
	TAS Kts.	206	207	208	206				
+10	Alt. FT.	9,350	11,100						
	Time Hr. Min.	47	34						
	Fuel, lbs.	4,150	2,780						
	TAS Kts.	212	211						
ISA	Alt. FT.	11,960							
	Time Hr. Min.	11							
	Fuel, lbs.	1,020							
	TAS Kts.	218							
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT
ALT. 16, 000 FT.

DRIFT DOWN THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ⇨	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ⇨	179	175	171	166	161	156	151	
+30	Alt. FT.				9, 300	11, 570	13, 850	15, 850	
	Time Hr. Min.				1:04	55	43	13	
	Fuel, lbs.				4, 810	4, 000	2, 950	900	
	TAS Kts.				204	206	207	205	
+20	Alt. FT.			10, 400	12, 470	14, 500			
	Time Hr. Min.			1:00	51	39			
	Fuel, lbs.			4, 850	3, 820	2, 790			
	TAS Kts.			209	209	208			
+10	Alt. FT.		11, 480	18, 360	15, 170				
	Time Hr. Min.		55	46	31				
	Fuel, lbs.		4, 550	3, 650	2, 330				
	TAS Kts.		214	216	215				
ISA	Alt. FT.	12, 550	14, 250	15, 800					
	Time Hr. Min.	49	39	17					
	Fuel, lbs.	4, 200	3, 220	1, 400					
	TAS Kts.	220	221	220					
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT
ALT. 14,000 FT.

DRIFT DOWN THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156		
+30	Alt. FT.			6,960	9,190	11,400	13,520		
	Time Hr. Min.			1:06	58	47	24		
	Fuel, lbs.			5,350	4,430	3,400	1,730		
	TAS Kts.			203	205	204	203		
+20	Alt. FT.		8,250	10,260	12,290	13,980			
	Time Hr. Min.		1:01	53	42	8			
	Fuel, lbs.		5,270	4,280	3,180	500			
	TAS Kts.		207	208	209	207			
+10	Alt. FT.	9,500	11,360	13,130					
	Time Hr. Min.	55	47	32					
	Fuel, lbs.	4,900	3,950	2,550					
	TAS Kts.	214	214	213					
ISA	Alt. FT.	12,390	13,880						
	Time Hr. Min.	39	15						
	Fuel, lbs.	3,350	1,230						
	TAS Kts.	218	218						
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 18, 000 FT.

DRIFT DOWN THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156	151	
+30	Alt. FT.					11, 650	14, 000	16, 310	
	Time Hr. Min.					1:01	52	39	
	Fuel, lbs.					4, 380	3, 530	2, 500	
	TAS Kts.					208	208	209	
+20	Alt. FT.				12, 570	14, 660	16, 720		
	Time Hr. Min.				58	50	36		
	Fuel, lbs.				4, 330	3, 520	2, 420		
	TAS Kts.				210	212	210		
+10	Alt. FT.		11, 570	13, 490	15, 390	17, 230			
	Time Hr. Min.		1:00	54	45	30			
	Fuel, lbs.		5, 000	4, 260	3, 330	2, 130			
	TAS Kts.		216	218	217	216			
ISA	Alt. FT.	12, 640	14, 400	16, 130	17, 730				
	Time Hr. Min.	55	48	39	20				
	Fuel, lbs.	4, 700	3, 980	3, 100	1, 500				
	TAS Kts.	220	222	223	221				
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 20,000 FT.

DRIFT DOWN

THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ⇨	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ⇨		175	171	166	161	156	151	146
+30	Alt. FT.						14,080	16,460	18,850
	Time Hr. Min.						58	49	34
	Fuel, lbs.						3,900	3,080	2,000
	TAS Kts.						210	210	208
+20	Alt. FT.					14,760	16,900	19,040	
	Time Hr. Min.					57	47	32	
	Fuel, lbs.					3,930	3,150	2,060	
	TAS Kts.					212	213	212	
+10	Alt. FT.			13,580	15,500	17,450	19,320		
	Time Hr. Min.			1:00	53	44	28		
	Fuel, lbs.			4,730	3,930	3,120	1,840		
	TAS Kts.			217	219	219	217		
ISA	Alt. FT.		14,490	16,260	18,010	19,680			
	Time Hr. Min.		54	48	39	21			
	Fuel, lbs.		4,450	3,760	2,940	1,500			
	TAS Kts.		221	223	225	223			
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 22,000 FT.

DRIFT DOWN THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷			171	166	161	156	151	146
+30	Alt. FT.							16,560	19,040
	Time Hr. Min.							56	46
	Fuel, lbs.							3,430	2,670
	TAS Kts.							210	211
+20	Alt. FT.						17,020	19,210	21,430
	Time Hr. Min.						54	43	27
	Fuel, lbs.						3,600	2,710	1,700
	TAS Kts.						213	215	213
+10	Alt. FT.				15,600	17,580	19,550	21,520	
	Time Hr. Min.				59	52	42	24	
	Fuel, lbs.				4,360	3,580	2,820	1,510	
	TAS Kts.				218	220	220	218	
ISA	Alt. FT.			16,340	18,130	19,930	21,660		
	Time Hr. Min.			54	47	39	20		
	Fuel, lbs.			4,170	3,550	2,800	1,400		
	TAS Kts.			223	224	222	221		
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 24,000 FT.

DRIFT DOWN

THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ⇨	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ⇨				166	161	156	151	146
+30	Alt. FT.								19,150
	Time Hr. Min.								53
	Fuel, lbs.								3,050
	TAS Kts.								210
+20	Alt. FT.						17,070	19,320	21,600
	Time Hr. Min.						59	51	41
	Fuel, lbs.						3,800	3,140	2,460
	TAS Kts.						213	215	216
+10	Alt. FT.					17,620	19,640	21,740	23,760
	Time Hr. Min.					57	50	40	17
	Fuel, lbs.					3,880	3,280	2,510	1,040
	TAS Kts.					220	221	221	219
ISA	Alt. FT.				18,190	20,010	21,890	23,710	
	Time Hr. Min.				53	47	38	19	
	Fuel, lbs.				3,870	3,280	2,550	1,280	
	TAS Kts.				223	224	225	223	
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT
ALT. 26,000 FT.

DRIFT DOWN

THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷				166	161	156	151	146
+30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
+20	Alt. FT.							19,390	21,730
	Time Hr. Min.							57	49
	Fuel, lbs.							3,450	2,860
	TAS Kts.							215	217
+10	Alt. FT.						19,700	21,840	24,050
	Time Hr. Min.						55	48	37
	Fuel, lbs.						3,570	2,980	2,280
	TAS Kts.						221	222	223
ISA	Alt. FT.				18,240	20,080	21,990	23,950	25,840
	Time Hr. Min.				58	52	47	38	19
	Fuel, lbs.				4,120	3,600	3,050	2,350	1,200
	TAS Kts.				223	224	225	223	222
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

3 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 30, 000 FT.

DRIFT DOWN

THREE ENGINES AT 95.1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷						156	151	146
+30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
+20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
+10	Alt. FT.								24, 300
	Time Hr. Min.								51
	Fuel, lbs.								2, 940
	TAS Kts.								223
ISA	Alt. FT.						22, 080	24, 100	26, 170
	Time Hr. Min.						56	51	45
	Fuel, lbs.						3, 510	3, 120	2, 650
	TAS Kts.						226	225	224
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 3 engines at 14, 500 LPRPM at the reduced weight.

4.1 Drift-down Path, Three Engines

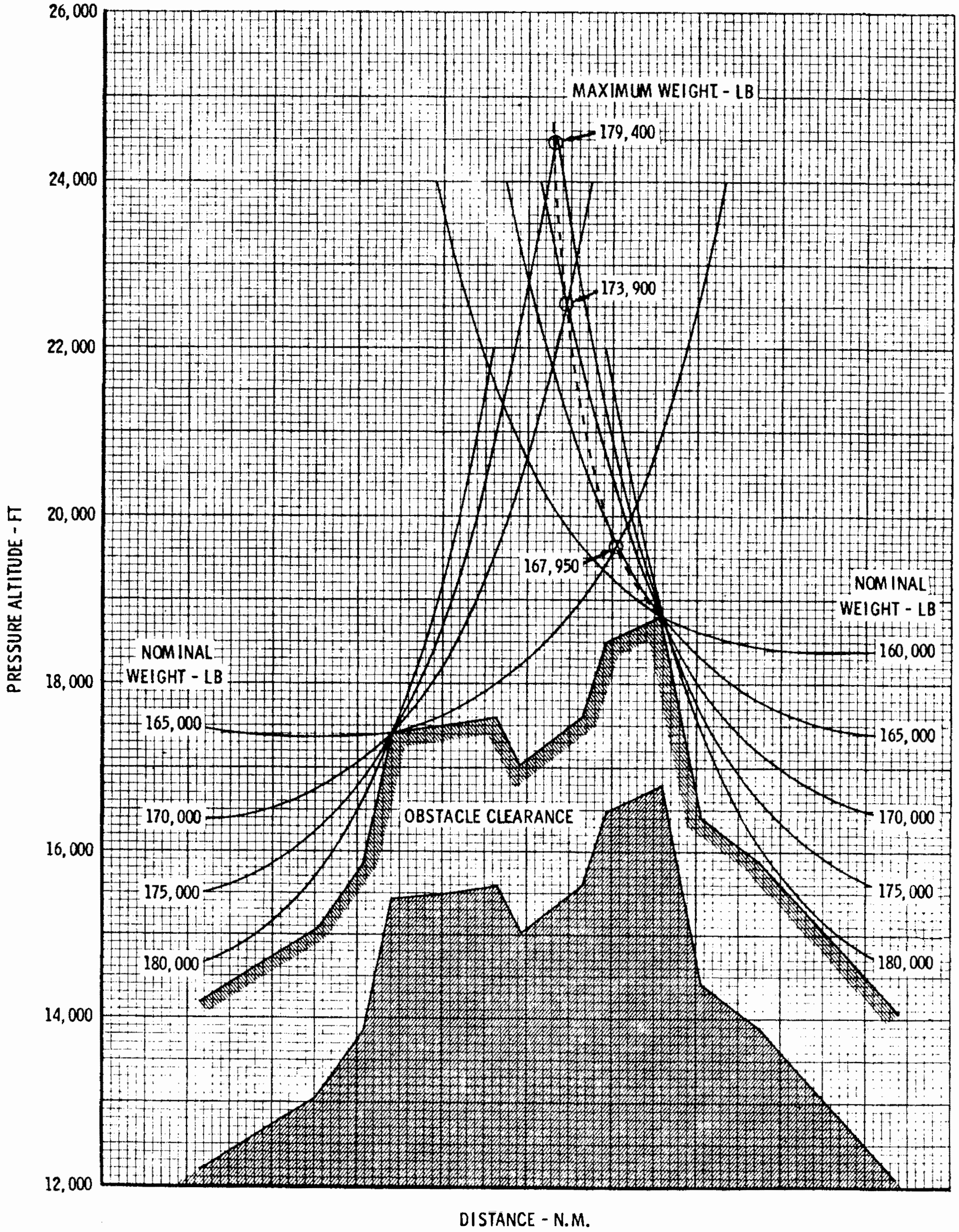
The drift-down path with three engines operating at 95.1% LP rpm, is represented for various weights, on Figures 3-2, 3-3, 3-4 and 3-5, which apply to temperature anomalies of ISA, ISA + 10°C, ISA + 20°C and ISA + 30°C respectively.

Use of Data

Figure 3-1 is reproduced to illustrate the working use of Figures 3-2 to 3-5, and similarly for the two engine drift down Figures 3-6 to 3-9.

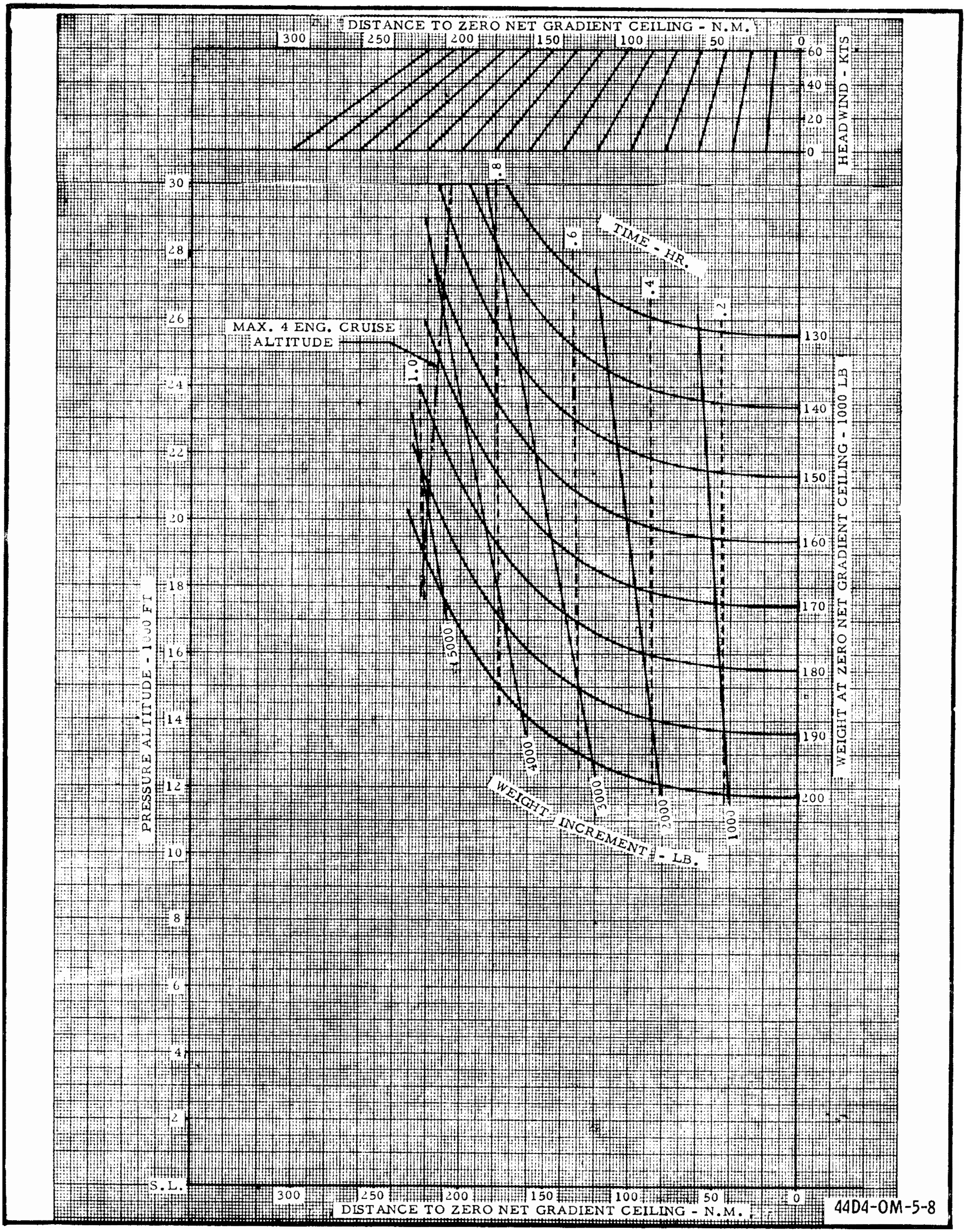
The terrain profile under review should be drawn on transparent paper to the same scale of altitude and horizontal distance used in Figures 3-2 to 3-9.

Choosing the proper figure based on the temperature anomoly being considered, the transparent drawing of the terrain profile should be laid on top, and matched to the corresponding altitude, and moved horizontally so that a flight path curve touches the obstacle clearance profile. The flight path should be sketched onto the transparency with points noted of fuel consumed, since the aircraft weight shown pertains to the final reduced weight, which was heavier during drift down by the amounts noted. Several flight paths should be sketched. The transparent profile curve should then be turned over, and the same procedure followed pertaining to the other opposite approach to the terrain. The intersection of common weight lines, from opposite approaches, will indicate a limiting weight and altitude. Joining these intersecting points will produce a locus of limiting weights and corresponding altitudes, which can then be cross-plotted for direct use.

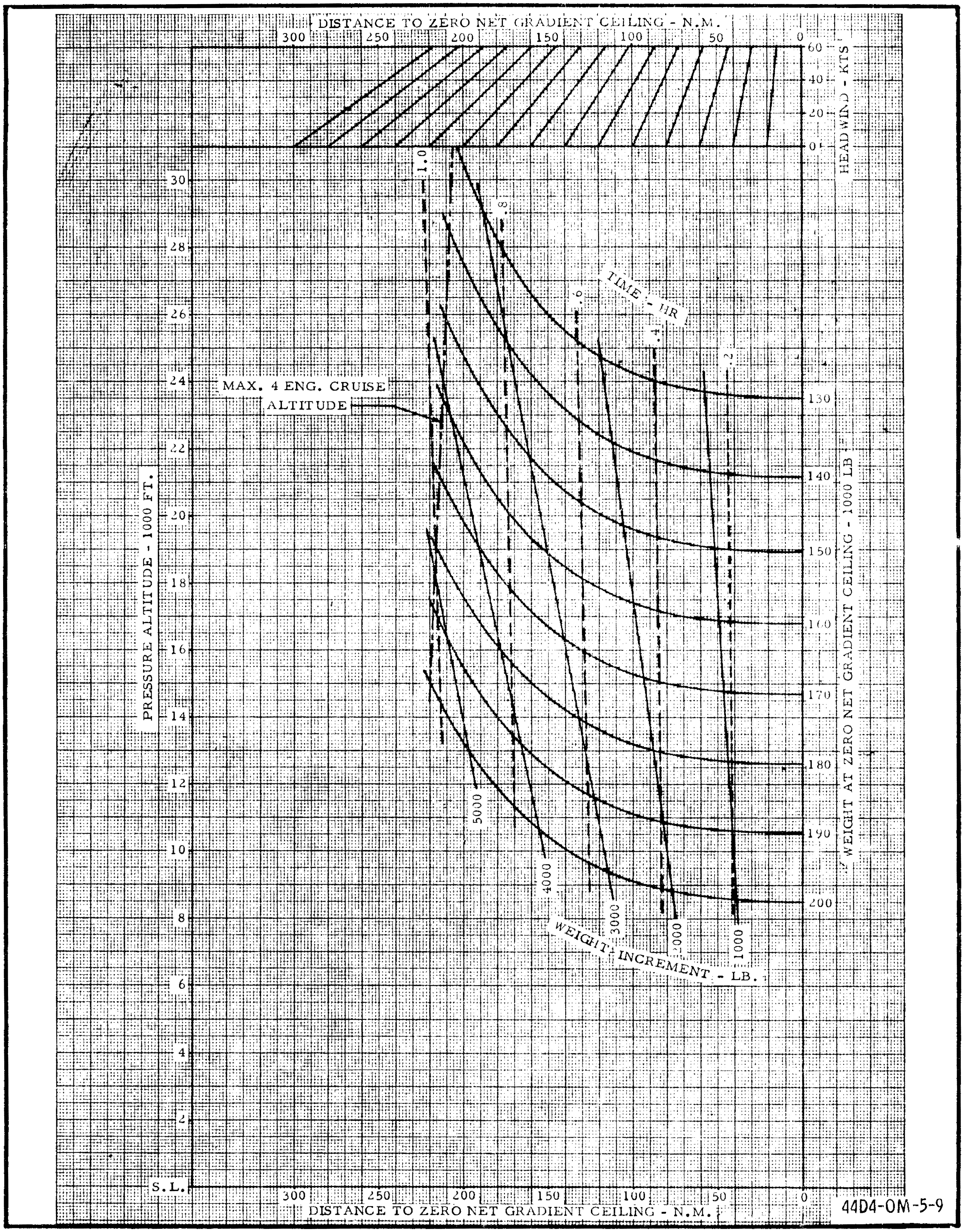


44D4-OM-05-5

Example of Chart Use
Figure 3-1

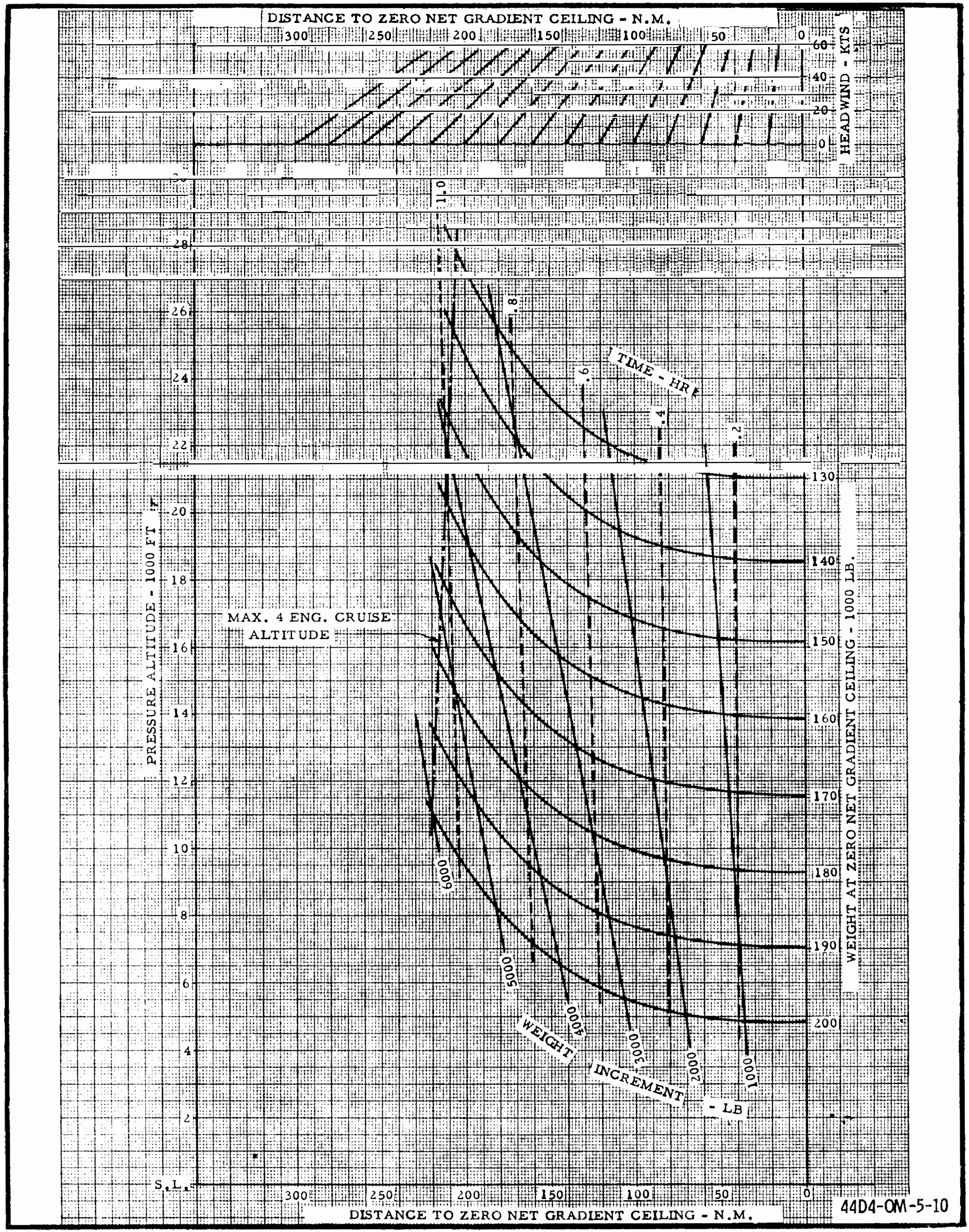


Drift-down Flight Path - Three Engines - ISA
Figure 3-2



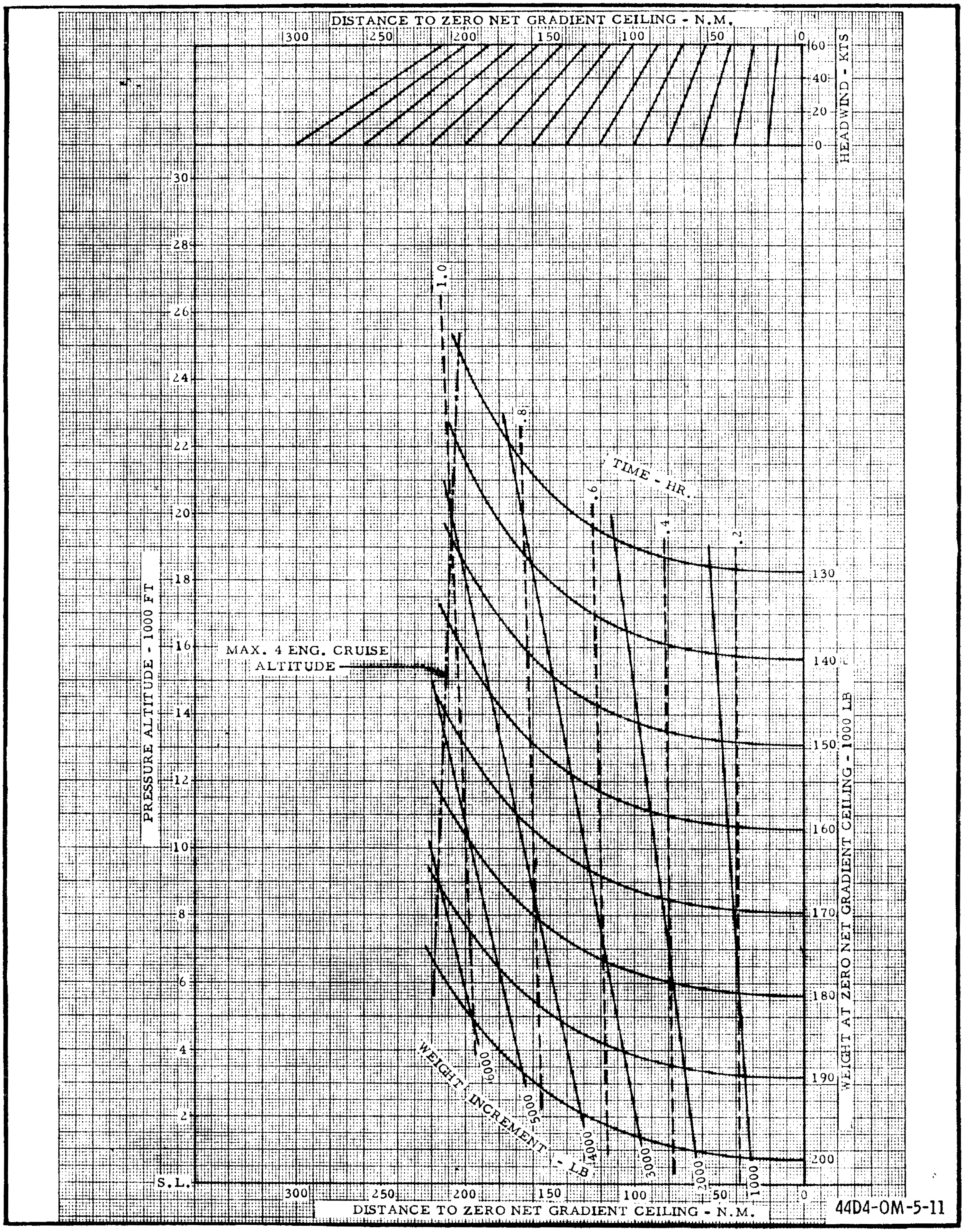
Drift-down Flight Path - Three Engines - ISA+10° C

Figure 3-3



Drift-down Flight Path - Three Engines - ISA+20°C

Figure 3-4



Drift-down Flight Path - Three Engines - ISA+30°C

Figure 3-5

5. Drift Down, Two Engines

The two engine drift-down data, with engine power at 95.1% LP rpm, is presented in Pages 3.59 to 3.69.

Assuming engine failure to occur while cruising at altitude, the data indicates the quantity of fuel consumed, the still air distance traversed, the average True Air Speed during drift.down, and the altitude at which the C.A.R. required climb gradient will be maintained at the final weight.

Each page relates to a specific altitude at which two engines are assumed to fail, and a table is thereby shown for every 2,000 foot altitude, between 10,000 feet and 30,000 feet.

For use in evaluating the terrain clearance, the drift-down path is given in Figures 3-6 to 3-9.

ENGINE FAILURE AT

ALT. 10,000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156	151	
+30	Alt. FT.				0	2,710	5,410	8,000	
	Time Hr. Min.				1:43	1:32	1:18	56	
	Fuel, lbs.				6,700	5,580	4,450	3,000	
	TAS Kts.				178	178	179	180	
+20	Alt. FT.				3,780	6,220	8,570		
	Time Hr. Min.				1:26	1:13	51		
	Fuel, lbs.				5,410	4,300	2,840		
	TAS Kts.				183	183	184		
+10	Alt. FT.		2,660	4,830	7,060	9,160			
	Time Hr. Min.		1:30	1:19	1:06	42			
	Fuel, lbs.		6,300	5,180	4,100	2,430			
	TAS Kts.		187	188	188	189			
ISA	Alt. FT.	3,900	5,950	7,950	9,750				
	Time Hr. Min.	1:23	1:13	57	26				
	Fuel, lbs.	6,000	4,980	3,700	1,600				
	TAS Kts.	192	193	193	193				
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 12, 000 FT.

DRIFT DOWN TWO ENGINES AT 95. 1% RPM

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156	151	146
+30	Alt. FT.				90	2, 810	5, 550	8, 230	10, 890
	Time Hr. Min.				1:49	1:38	1:26	1:11	47
	Fuel, lbs.				6, 690	5, 920	4, 900	3, 750	2, 400
	TAS Kts.				179	179	180	180	181
+20	Alt. FT.				3, 860	6, 360	8, 790	11, 200	
	Time Hr. Min.				1:32	1:21	1:07	41	
	Fuel, lbs.				5, 710	4, 800	3, 660	2, 230	
	TAS Kts.				184	185	185	186	
+10	Alt. FT.		2, 730	4, 930	7, 200	9, 500	11, 430		
	Time Hr. Min.		1:36	1:27	1:15	1:02	31		
	Fuel, lbs.		6, 630	5, 660	4, 650	3, 620	1, 290		
	TAS Kts.		188	189	190	190	191		
ISA	Alt. FT.	3, 980	6, 060	8, 120	10, 140	11, 920			
	Time Hr. Min.	1:30	1:21	1:10	55	17			
	Fuel, lbs.	6, 400	5, 500	4, 500	3, 300	960			
	TAS Kts.	193	193	194	194	194			
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

2 engines at 14, 500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 14,000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156	151	146
+30	Alt. FT.				130	2,890	5,650	8,400	11,160
	Time Hr. Min.				1:53	1:42	1:33	1:21	1:07
	Fuel, lbs.				7,100	6,170	5,220	4,280	3,280
	TAS Kts.				179	181	182	182	182
+20	Alt. FT.				3,930	6,440	8,950	11,480	13,780
	Time Hr. Min.				1:38	1:28	1:17	1:02	23
	Fuel, lbs.				6,000	5,120	4,240	3,170	1,150
	TAS Kts.				185	186	186	187	187
+10	Alt. FT.		2,770	5,010	7,320	9,640	11,900	13,920	
	Time Hr. Min.		1:41	1:32	1:23	1:13	57	17	
	Fuel, lbs.		6,880	5,950	5,100	4,220	3,100	920	
	TAS Kts.		189	191	191	191	192	192	
ISA	Alt. FT.	4,050	6,150	8,260	10,320	12,380			
	Time Hr. Min.	1:35	1:28	1:19	1:09	52			
	Fuel, lbs.	6,780	5,900	5,080	4,100	2,900			
	TAS Kts.	194	195	195	195	195			
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 16,000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156	151	146
+30	Alt. FT.					2,950	5,700	8,490	11,290
	Time Hr. Min.					1:47	1:37	1:27	1:15
	Fuel, lbs.					6,350	5,400	4,550	3,680
	TAS Kts.					181	183	185	185
+20	Alt. FT.				3,990	6,500	9,040	11,630	13,910
	Time Hr. Min.				1:43	1:33	1:24	1:13	54
	Fuel, lbs.				6,150	5,350	4,570	3,710	1,630
	TAS Kts.				185	187	188	188	189
+10	Alt. FT.		2,820	5,080	7,390	9,730	12,040	14,370	
	Time Hr. Min.		1:44	1:37	1:29	1:20	1:09	52	
	Fuel, lbs.		7,050	6,240	5,370	4,620	3,720	2,660	
	TAS Kts.		191	191	192	193	193	193	
ISA	Alt. FT.	4,120	6,220	8,330	10,450	12,550	14,630		
	Time Hr. Min.	1:40	1:32	1:25	1:16	1:05	48		
	Fuel, lbs.	7,030	6,200	5,400	4,630	3,660	2,500		
	TAS Kts.	194	196	196	196	196	196		
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT ALT. 18, 000 FT.

DRIFT DOWN TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts.	179	175	171	166	161	156	151	146
+30	Alt. FT.					2, 990	5, 780	8, 570	11, 400
	Time Hr. Min.					1:50	1:42	1:33	1:23
	Fuel, lbs.					6, 500	5, 630	4, 800	4, 050
	TAS Kts.					183	184	185	186
+20	Alt. FT.				4, 020	6, 540	9, 090	11, 730	14, 360
	Time Hr. Min.				1:47	1:38	1:29	1:20	1:07
	Fuel, lbs.				6, 280	5, 500	4, 780	4, 020	3, 170
	TAS Kts.				187	188	189	189	190
+10	Alt. FT.		2, 840	5, 120	7, 440	9, 790	12, 150	14, 550	16, 870
	Time Hr. Min.		1:48	1:41	1:34	1:26	1:17	1:06	44
	Fuel, lbs.		7, 150	6, 380	5, 550	4, 800	4, 100	3, 320	2, 130
	TAS Kts.		192	193	193	193	194	195	195
ISA	Alt. FT.	4, 150	6, 260	8, 410	10, 510	12, 660	14. 810	16, 920	
	Time Hr. Min.	1:44	1:37	1:30	1:22	1:14	1:02	43	
	Fuel, lbs.	7, 250	6, 420	5, 660	4, 920	4, 150	3, 260	2, 150	
	TAS Kts.	195	197	197	197	197	197	197	
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT
ALT. 20,000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts.	179	175	171	166	161	156	151	146
+30	Alt. FT.						5,800	8,620	11,460
	Time Hr. Min.						1:46	1:37	1:28
	Fuel, lbs.						5,750	4,960	4,250
	TAS Kts.						185	186	187
+20	Alt. FT.					6,580	9,130	11,780	14,450
	Time Hr. Min.					1:42	1:34	1:25	1:14
	Fuel, lbs.					5,600	4,910	4,230	3,470
	TAS Kts.					189	190	191	192
+10	Alt. FT.			5,140	7,470	9,820	12,200	14,640	17,070
	Time Hr. Min.			1:45	1:38	1:31	1:23	1:14	1:01
	Fuel, lbs.			6,480	5,720	4,970	4,320	3,700	2,860
	TAS Kts.			193	194	194	196	196	196
ISA	Alt. FT.	4,210	6,280	8,450	10,580	12,720	14,920	17,100	19,230
	Time Hr. Min.	1:48	1:41	1:34	1:27	1:19	1:11	1:00	39
	Fuel, lbs.	7,450	6,470	5,870	5,150	4,440	3,750	2,970	1,860
	TAS Kts.	196	197	198	198	198	199	199	199
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 22,000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷		175	171	166	161	156	151	146
+30	Alt. FT.							8,650	11,470
	Time Hr. Min.							1:41	1:32
	Fuel, lbs.							5,100	4,380
	TAS Kts.							188	189
+20	Alt. FT.						9,150	11,820	14,500
	Time Hr. Min.						1:38	1:30	1:20
	Fuel, lbs.						4,980	4,380	3,660
	TAS Kts.						191	192	193
+10	Alt. FT.				7,490	9,860	12,240	14,700	17,160
	Time Hr. Min.				1:41	1:34	1:27	1:20	1:09
	Fuel, lbs.				5,780	5,110	4,450	3,900	3,250
	TAS Kts.				196	196	197	197	198
ISA	Alt. FT.		6,320	8,490	10,610	12,800	15,000	17,200	19,330
	Time Hr. Min.		1:43	1:37	1:31	1:24	1:17	1:09	56
	Fuel, lbs.		6,630	6,000	5,300	4,650	4,030	3,400	2,650
	TAS Kts.		199	200	200	200	200	200	200
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on

2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 24, 000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156	151	146
+30	Alt. FT.								11, 540
	Time Hr. Min.								1:36
	Fuel, lbs.								4, 530
	TAS Kts.								189
+20	Alt. FT.						9, 160	11, 830	14, 560
	Time Hr. Min.						1:41	1:33	1:25
	Fuel, lbs.						5, 010	4, 440	3, 820
	TAS Kts.						192	193	194
+10	Alt. FT.					9, 880	12, 260	14, 730	17, 200
	Time Hr. Min.					1:38	1:32	1:24	1:15
	Fuel, lbs.					5, 170	4, 560	4, 010	3, 420
	TAS Kts.					197	197	199	199
ISA	Alt. FT.			8, 500	10, 630	12, 830	15, 050	17, 250	19, 540
	Time Hr. Min.			1:40	1:34	1:28	1:22	1:15	1:06
	Fuel, lbs.			6, 080	5, 420	4, 800	4, 220	3, 640	3, 100
	TAS Kts.			201	201	201	201	201	201
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 26,000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight ⇨	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ⇨	179	175	171	166	161	156	151	146
+30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
+20	Alt. FT.							11,840	14,570
	Time Hr. Min.							1:37	1:29
	Fuel, lbs.							4,450	3,880
	TAS Kts.							194	195
+10	Alt. FT.						12,280	14,750	17,230
	Time Hr. Min.						1:35	1:28	1:20
	Fuel, lbs.						4,600	4,100	3,600
	TAS Kts.						199	199	200
ISA	Alt. FT.				10,650	12,850	15,080	17,320	19,620
	Time Hr. Min.				1:37	1:32	1:26	1:20	1:13
	Fuel, lbs.				5,500	4,900	4,380	3,850	3,380
	TAS Kts.				202	202	202	202	202
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 28,000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

°C Dev. from Std. Temp.	Gross Weight ⇨	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ⇨	179	175	171	166	161	156	151	146
+30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
+20	Alt. FT.								14,580
	Time Hr. Min.								1:33
	Fuel, lbs.								3,930
	TAS Kts.								195
+10	Alt. FT.							14,770	17,270
	Time Hr. Min.							1:31	1:24
	Fuel, lbs.							4,150	3,660
	TAS Kts.							201	201
ISA	Alt. FT.					12,850	15,090	17,360	19,660
	Time Hr. Min.					1:34	1:29	1:24	1:17
	Fuel, lbs.					4,920	4,450	4,000	3,500
	TAS Kts.					204	204	204	204
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 2 engines at 14,500 LPRPM at the reduced weight.

ENGINE FAILURE AT

ALT. 30, 000 FT.

DRIFT DOWN

TWO ENGINES AT 95.1% RPM.

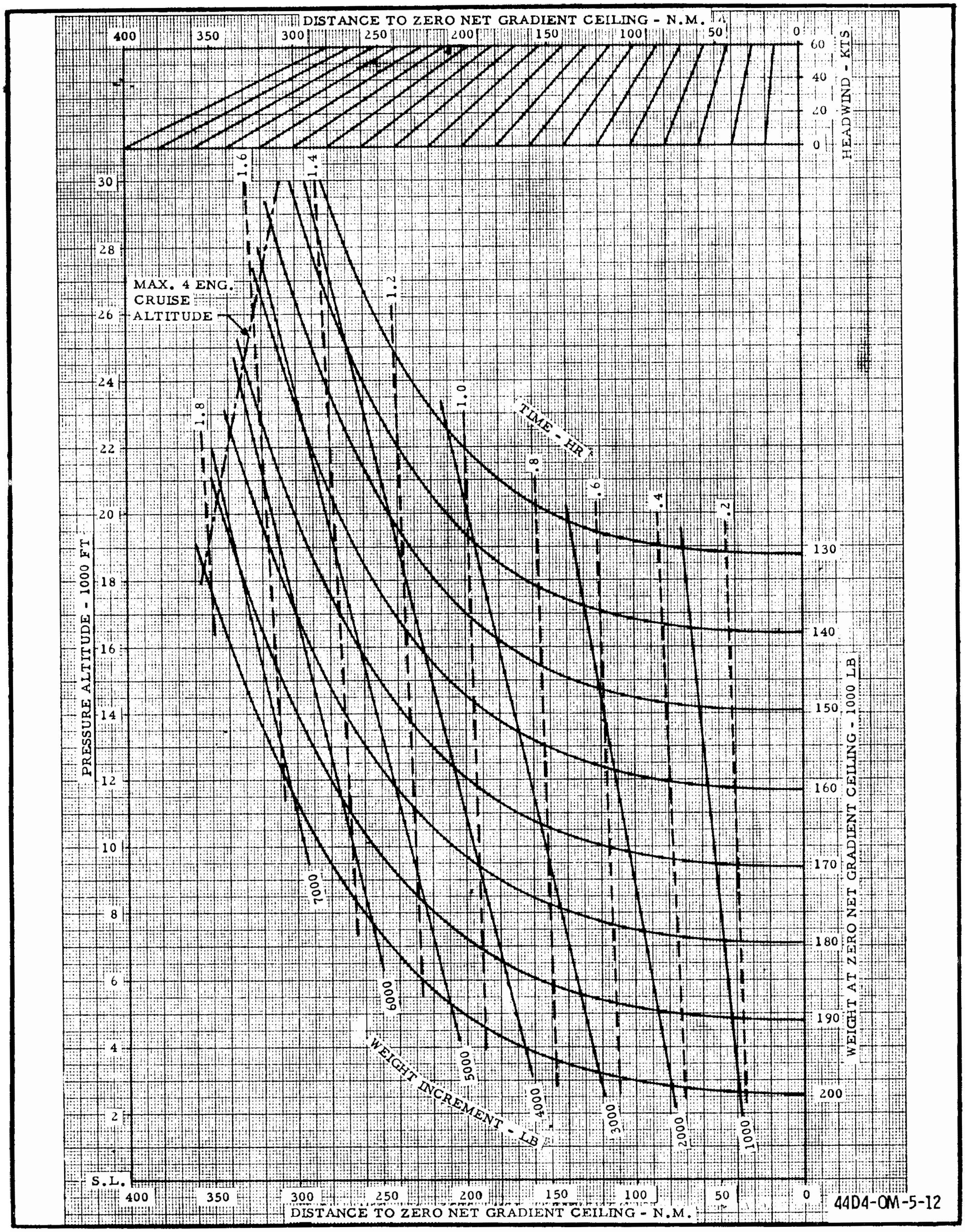
°C Dev. from Std. Temp.	Gross Weight ▷	200,000	190,000	180,000	170,000	160,000	150,000	140,000	130,000
	IAS Kts. ▷	179	175	171	166	161	156	151	146
+30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
+20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
+10	Alt. FT.								17, 290
	Time Hr. Min.								1:27
	Fuel, lbs.								3, 710
	TAS Kts.								202
ISA	Alt. FT.						15, 090	17, 380	19, 690
	Time Hr. Min.						1:31	1:26	1:21
	Fuel, lbs.						4, 470	4, 060	3, 640
	TAS Kts.						206	206	206
-10	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-20	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								
-30	Alt. FT.								
	Time Hr. Min.								
	Fuel, lbs.								
	TAS Kts.								

The altitudes shown are those which can be maintained on 2 engines at 14,500 LPRPM at the reduced weight.

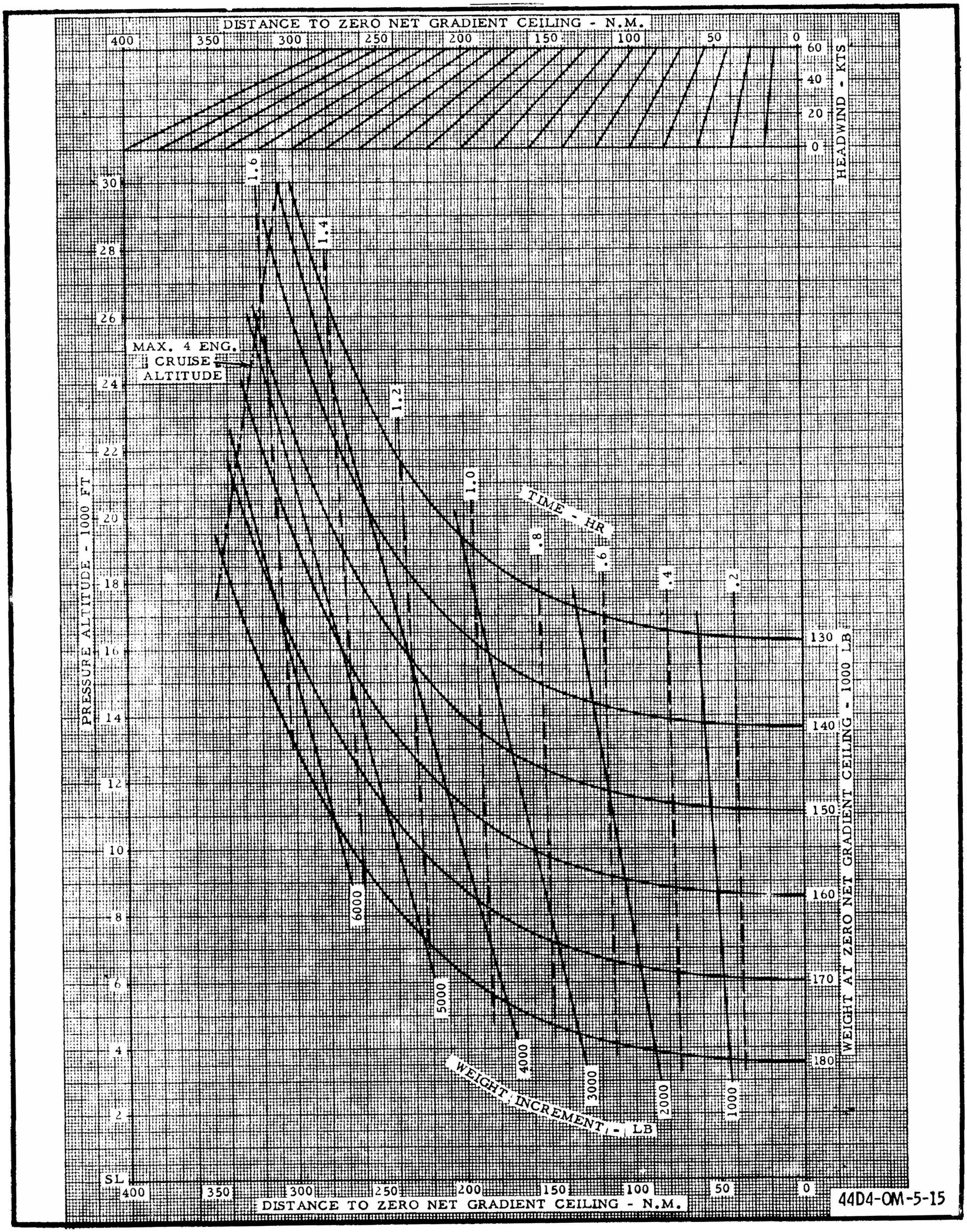
5.1 Drift-down Path, Two Engines

The flight path during drift down with two engines inoperative and two engines operating at 95.1% LP rpm are presented for various weights, and separated as to temperature anomaly in Figures 3-6 to 3-9.

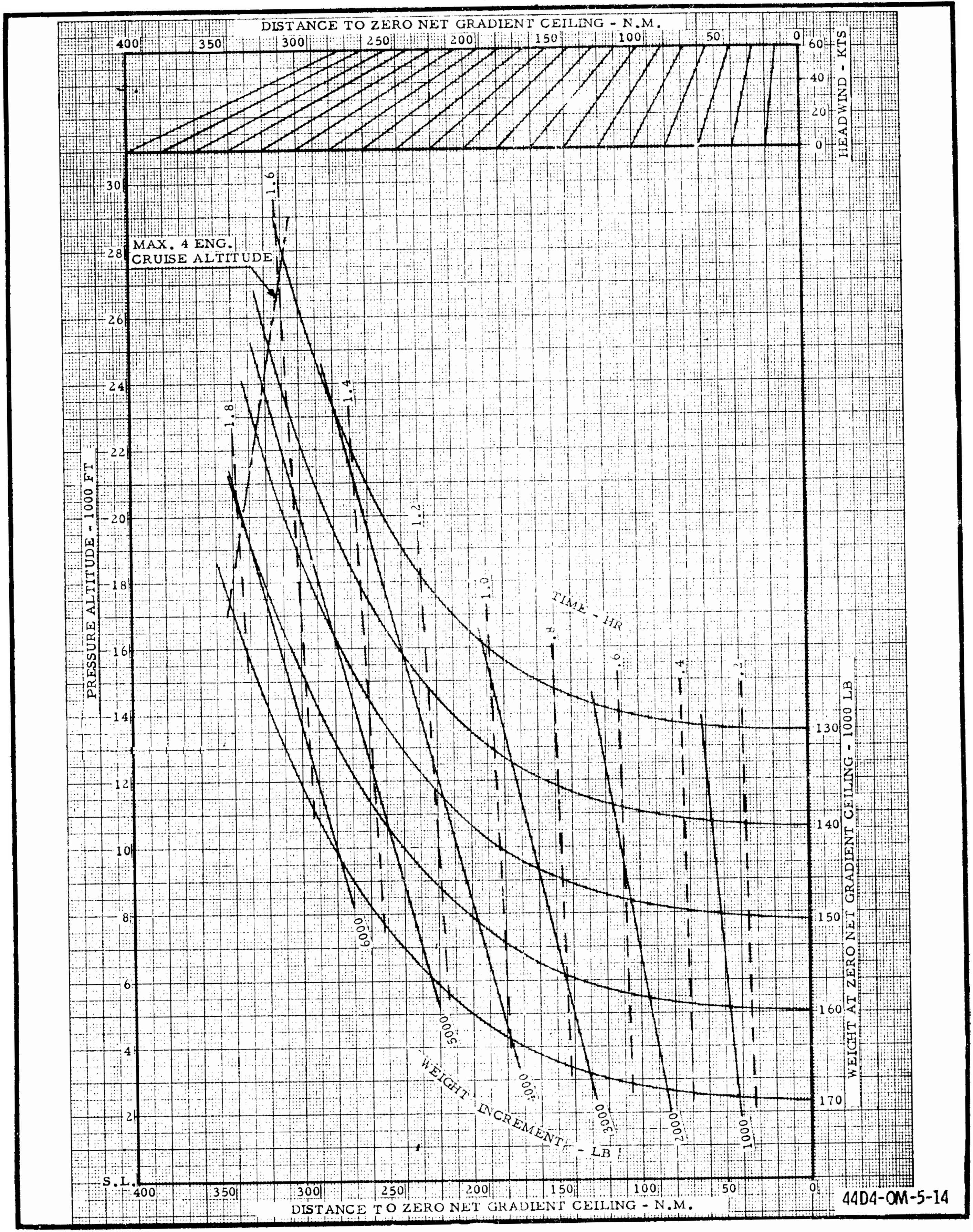
Reference should be made to Pages 3.52 and 3.53 for an explanation of their use.



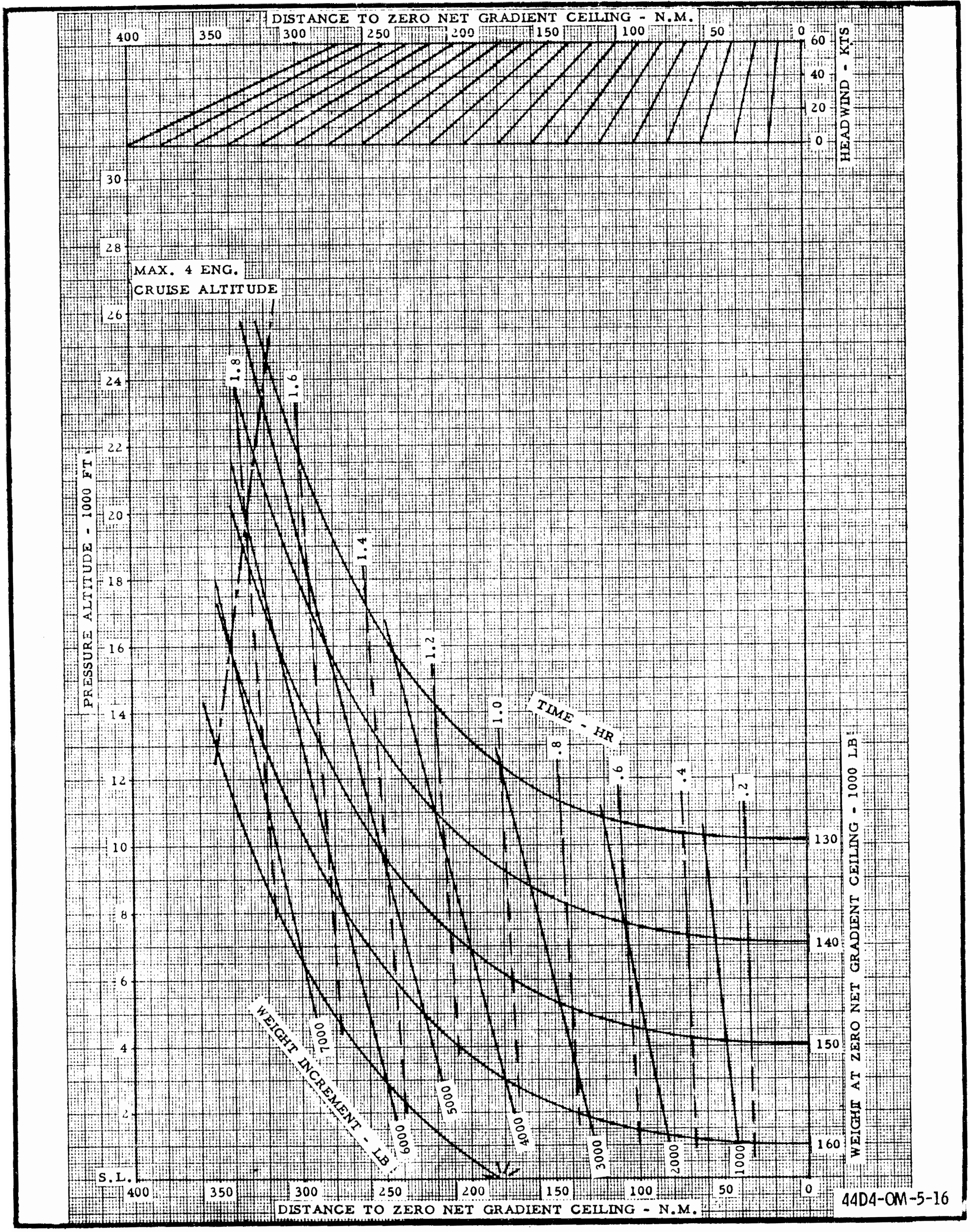
Drift-down Flight Path - Two Engines - ISA
Figure 3-6



Drift-down Flight Path - Two Engines - ISA+10°C
Figure 3-7



Drift-down Flight Path - Two Engines - ISA+20°C
Figure 3-8



Drift-down Flight Path - Two Engines - ISA+30°C

Figure 3-9

SECTION 5

PART 1A THROUGH 3A.6

1. Fuel Flow Control Charts - 88.5% L.P.R.P.M.

Rolls Royce recommend operating the engine to a specific fuel flow setting for both climb and cruise, as this has proved to be the most reliable technique for controlling turbine entry temperatures, resulting in an improved hot end component lives.

The following instructions and charts relating to this procedure have been drawn up by Rolls Royce as part of their recommended operating instructions contained in Rolls Royce Publication F-TY1-C. They should be used in conjunction with the climb and cruise tables. (Ref. Sec. 5, Page 2.2 through 3.67)

Important

Immediately after reducing R.P.M. for the climb, check the indicated O.A.T. and pressure altitude and trim the synchroscope master engine fuel flow to chart value ensuring the T.G.T. limit given in the chart is not exceeded. Trim other three engines to chart value when synchronized to master engine observing T.G.T. limit. The fuel flow should be checked and reset as required, at intervals not greater than 4,000 feet.

In cruise, set the condition levers to obtain the fuel flow given in Pages 3A.1 to 3A.6 observing T.G.T. limits. Cross check with normal cruise charts, Sec. 5, Page 2.11 through 2.57, to obtain best performance.

When hot air anti-icing is in use, the reduction in fuel flow required may be obtained from charts 2A.1 through 3A.6.

TYNE Mk.515 - MAXIMUM CONTINUOUS AT 94.9% (14500) L.P. R.P.M. AND 1221 deg.K.

CONDITION LEVER POSITION - WITHOUT HOT AIR ANTI-ICING

Alt. Feet	MOD. 1426 Max.TOT. deg.C.								R	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	PRE-MOD. 1426 Max.TOT. deg.C.
-2000	645	23	24	25	26	27	28	29	30	31	32	33	34	35		36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	57	58	59											715
-1000	645	17	18	20	21	22	23	24	25	26	27	28	29	30		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	53	54	55	56									715
SL	645	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	49	50	51	53	54	55						715
1000	647	8	9	10	11	12	13	14	15	16	17	18	19	20	22		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	47	49	50	51	52	53				717
2000	650	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		28	29	30	31	32	33	34	35	36	37	38	40	41	42	43	44	46	47	48	49	51	52				720
3000	652	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	48	49	50				722
4000	655	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	41	42	43	44	46	47	48				725
5000	657	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	41	42	44	45	46				727
6000	660	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	40	42	43	44				730
7000	662	2	1	0		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	38	40	41	42				732
8000	665	4	3	2	1	0		1	2	3	4	5	6	7	8	9	10	11	12	13	14		15	16	17	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	38	39	40	41			735
9000	667	6	5	4	3	2	1		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	28	29	31	32	33	34	35	37	38	39				737
10000	670	8	7	6	5	4	3	2		1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	29	30	31	32	33	35	36	37				740
11000	672	11	9	8	7	6	5	4	3		2	1	0	1	2	3	4	5	6	7		8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25	27	28	29	30	31	33	34	35			742
12000	675	13	12	11	9	8	7	6	5	4	3		2	1	0	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	23	25	26	27	28	30	31	32	33			745
13000	677	16	14	13	12	11	9	8	7	6	5	4		3	2	1	0	1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	24	25	26	27	29	30	31			747
14000	680	18	17	16	14	13	12	11	10	8	7		6	5	4	3	2	1	0	1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	22	23	24	25	26	28	29	30		750
15000	682	21	20	18	17	16	15	14	12	11	10	9	8	7	6	5	4	3	2		1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	22	23	24	25	26	27	28	752
16000	685	23	22	21	20	19	17	16	15	14	13	11	10	9	8	7	6	5		4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	17	18	19	21	22	23	24	25	26	755
17000	687	26	25	24	22	21	20	19	18	16	15	14	13	12	11	9	8		7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	18	20	21	22	23	24	757
18000	690	29	28	26	25	24	23	21	20	19	18	17	16	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		1	2	3	4	5	6	7	9	10	11	12	14	15	16	17	18	19	21		760
19000	692	32	31	29	28	26	25	24	23	22	20	19	18	17	16	15	14	12	11	10	9	8	7	6	5	4	3	2		1	0	1	2	3	4	5	7	8	9	10	11	13	14	15	16	17	18	19	762
20000	695	35	34	32	31	29	28	27	25	24	23	22	21	20	19	17	16	15	14	13	12	10	9	8	7	6	5	4		3	2	1	0	1	2	3	4	6	7	8	9	10	12	13	14	15	16	17	765
21000	697	38	36	35	33	32	31	30	28	27	26	24	23	22	21	20	19	18	17	15	14	13	12	11	10	8	7	6		5	4	3	2	1	0	1	2	4	5	6	7	8	10	11	12	13	14	15	767
22000	700	41	40	38	36	35	34	32	31	30	28	27	26	25	23	22	21	20	19	18	17	15	14	13	12	11	10	9	8	6		5	4	3	2	1	1	2	3	4	5	6	8	9	10	11	12	13	770
23000	702	44	42	41	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	17	16	14	13	12	11	10	9	7	6	5	4	3	2	1	0	1	2	3	4	6	7	8	9	10	11	772
24000	705	46	45	44	42	41	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	17	16	14	13	12	11	10	8	7	6	5	4	3	2	1	0	1	3	4	5	6	7	8	9	775
25000	707	50	48	46	45	43	42	41	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	17	16	14	13	12	11	9	8	7	6	5	4	3	2	0	1	2	3	4	5	6	7	777
26000	710	52	50	49	47	46	45	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	23	22	20	19	18	17	15	14	13	12	10	9	8	7	6	5	3	2	1	0	1	2	3	4	5	780
27000	712	55	53	51	50	49	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	22	21	20	19	18	16	15	14	13	11	10	9	8	6	5	4	3	2	1	0	1	2	3	782
28000	715	57	56	54	53	51	50	48	47	46	44	43	42	40	39	37	36	35	33	32	31	29	28	27	26	24	23	22	21	20	19	17	16	15	13	12	11	9	8	7	6	5	3	2	1	0	1		785
29000	717	60	58	57	55	54	52	51	49	48	47	45	44	43	41	40	39	37	36	34	33	32	30	29	28	27	25	24	23	22	21	19	18	17	16	14	13	11	10	9	7	6	5	4	3	2	1	0	787
30000	720	62	61	59	58	56	55	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	23	21	20	19	18	16	15	13	12	10	9	8	7	5		4	3	2	790

INDICATED AIR TEMPERATURE deg.C.

CONDITION LEVER POSITION - WITH HOT AIR ANTI-ICING

PRE-MOD.
1313,1314..... R 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4

MOD.1313,1314......... R 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6

NOTE: Indicated air temperatures below the stepped line are below 0 deg.C.

20449

TYNE MK 515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITHOUT ANTI-ICING

150 Kts I.A.S.

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW lb. per hour																			* MAX TGT °C.
0	600	10/2165	12/2165	14/2140	16/2105	18/2080	20/2050	22/2020	24/1990	26/1960	28/1935	30/1905	32/1880	34/1855	36/1830	38/1800	40/1775	42/1750	44/1725	46/1700	660
1	601	8/2115	10/2115	12/2090	14/2060	16/2035	18/2005	20/1975	22/1950	24/1920	26/1890	28/1870	30/1845	32/1815	34/1790	36/1765	38/1740	40/1715	42/1690	44/1665	661
2	603	6/2070	8/2070	10/2050	12/2015	14/1990	16/1960	18/1930	20/1905	22/1880	24/1855	26/1830	28/1805	30/1775	32/1750	34/1725	36/1700	38/1675	40/1655	42/1630	663
3	604	4/2020	6/2020	8/2005	10/1970	12/1950	14/1920	16/1890	18/1865	20/1840	22/1815	24/1790	26/1765	28/1740	30/1715	32/1690	34/1665	36/1645	38/1620	40/1600	664
4	606	2/1975	4/1975	6/1965	8/1930	10/1905	12/1880	14/1850	16/1825	18/1800	20/1775	22/1750	24/1730	26/1705	28/1680	30/1655	32/1630	34/1610	36/1585	38/1565	666
5	607	0/1935	2/1935	4/1920	6/1890	8/1865	10/1840	12/1810	14/1785	16/1760	18/1740	20/1715	22/1690	24/1665	26/1645	28/1620	30/1595	32/1575	34/1550	36/1530	667
6	609	2/1890	0/1890	2/1880	4/1850	6/1820	8/1800	10/1770	12/1750	14/1725	16/1700	18/1675	20/1655	22/1630	24/1605	26/1580	28/1560	30/1540	32/1515	34/1495	669
7	610	4/1865	2/1845	0/1835	2/1810	4/1780	6/1760	8/1730	10/1710	12/1685	14/1665	16/1640	18/1620	20/1595	22/1570	24/1545	26/1530	28/1505	30/1485	32/1465	670
8	612	6/1805	4/1805	2/1795	0/1770	2/1740	4/1720	6/1695	8/1670	10/1650	12/1625	14/1605	16/1580	18/1560	20/1535	22/1510	24/1495	26/1470	28/1450	30/1430	672
9	613	8/1765	6/1765	4/1755	2/1725	0/1705	2/1680	4/1660	6/1635	8/1610	10/1590	12/1570	14/1545	16/1525	18/1500	20/1480	22/1460	24/1440	26/1420	28/1400	673
10	615	10/1725	8/1725	6/1715	4/1685	2/1665	0/1640	2/1620	4/1600	6/1575	8/1555	10/1535	12/1510	14/1495	16/1465	18/1445	20/1425	22/1405	24/1385	26/1365	675
11	616	12/1685	10/1685	8/1675	6/1650	4/1625	2/1600	0/1580	2/1560	4/1540	6/1520	8/1495	10/1475	12/1455	14/1440	16/1410	18/1395	20/1370	22/1355	24/1335	676
12	618	14/1645	12/1650	10/1640	8/1610	6/1590	4/1570	2/1545	0/1520	2/1480	4/1480	6/1460	8/1440	10/1420	12/1400	14/1380	16/1360	18/1340	20/1320	22/1300	678
13	619	16/1610	14/1610	12/1600	10/1575	8/1550	6/1530	4/1510	2/1485	0/1470	2/1450	4/1430	6/1410	8/1390	10/1365	12/1345	14/1330	16/1310	18/1290	20/1270	679
14	621	18/1570	16/1570	14/1560	12/1540	10/1515	8/1495	6/1475	4/1450	2/1435	0/1415	2/1390	4/1375	6/1355	8/1330	10/1315	12/1295	14/1280	16/1260	18/1240	681
15	622	20/1540	18/1540	16/1525	14/1500	12/1480	10/1460	8/1440	6/1420	4/1400	2/1380	0/1360	2/1340	4/1320	6/1300	8/1280	10/1265	12/1245	14/1230	16/1210	682
16	624	22/1505	20/1505	18/1490	16/1465	14/1445	12/1425	10/1405	8/1385	6/1365	4/1345	2/1325	0/1305	2/1290	4/1270	6/1250	8/1235	10/1215	12/1200	14/1185	684
17	625	24/1470	22/1470	20/1440	18/1430	16/1410	14/1390	12/1370	10/1350	8/1330	6/1315	4/1295	2/1275	0/1255	2/1240	4/1220	6/1205	8/1185	10/1170	12/1155	685
18	627	26/1430	24/1430	22/1415	20/1395	18/1375	16/1355	14/1335	12/1320	10/1300	8/1280	6/1265	4/1245	2/1225	0/1210	2/1190	4/1175	6/1155	8/1140	10/1125	687
19	628	28/1395	26/1395	24/1375	22/1355	20/1335	18/1320	16/1300	14/1285	12/1265	10/1250	8/1230	6/1215	4/1195	2/1180	0/1160	2/1145	4/1130	6/1115	8/1100	688
20	630	30/1365	28/1360	26/1340	24/1320	22/1305	20/1285	18/1270	16/1250	14/1235	12/1220	10/1205	8/1185	6/1170	4/1150	2/1135	0/1120	2/1105	4/1085	6/1070	690
21	631	32/1330	30/1330	28/1310	26/1290	24/1270	22/1255	20/1240	18/1220	16/1205	14/1190	12/1175	10/1155	8/1140	6/1125	4/1105	2/1090	0/1075	2/1060	4/1045	691
22	633	34/1300	32/1295	30/1275	28/1260	26/1240	24/1225	22/1210	20/1190	18/1175	16/1160	14/1145	12/1125	10/1110	8/1095	6/1080	4/1060	2/1050	0/1030	2/1015	693
23	634	36/1265	34/1250	32/1240	30/1225	28/1205	26/1190	24/1175	22/1160	20/1145	18/1130	16/1115	14/1100	12/1080	10/1065	8/1050	6/1035	4/1020	2/1005	0/990	694
24	636	38/1230	36/1220	34/1205	32/1190	30/1170	28/1160	26/1145	24/1130	22/1115	20/1100	18/1085	16/1070	14/1055	12/1040	10/1025	8/1010	6/995	4/980	2/965	696
25	637	40/1200	38/1190	36/1170	34/1155	32/1140	30/1125	28/1110	26/1095	24/1080	22/1070	20/1055	18/1040	16/1030	14/1015	12/995	10/985	8/970	6/955	4/945	697
26	639	42/1170	40/1155	38/1140	36/1125	34/1110	32/1095	30/1080	28/1065	26/1055	24/1040	22/1025	20/1015	18/1000	16/985	14/970	12/960	10/945	8/930	6/920	699
27	640	44/1130	42/1120	40/1105	38/1095	36/1080	34/1065	32/1050	30/1040	28/1030	26/1015	24/1000	22/985	20/975	18/960	16/945	14/935	12/920	10/910	8/895	700
28	642	46/1100	44/1090	42/1075	40/1060	38/1050	36/1035	34/1020	32/1010	30/1000	28/985	26/975	24/960	22/945	20/935	18/920	16/910	14/895	12/885	10/870	702
29	643	48/1070	46/1055	44/1045	42/1030	40/1020	38/1005	36/995	34/980	32/970	30/960	28/945	26/920	24/930	22/910	20/895	18/885	16/870	14/860	12/845	703
30	645	50/1035	48/1025	46/1010	44/1000	42/985	40/975	38/965	36/950	34/940	32/930	30/920	28/910	26/895	24/885	22/870	20/860	18/850	16/835	14/825	705

† MOD.1426

* PRE-MOD.1426

NOTES 1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE

2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

TYNE MK 515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITH ANTI-ICING

150 Kts.I.A.S.

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C/FUEL FLOW lb. per hour																			* MAX TGT °C.
0	600	2/2165	4/2165	6/2140	8/2105	10/2080	12/2050	14/2020	16/1990	18/1960	20/1935	22/1905	24/1880	26/1855	28/1830	30/1800	32/1775	34/1750	36/1725	38/1700	660
1	601	0/2115	2/2115	4/2090	6/2060	8/2035	10/2005	12/1975	14/1950	16/1920	18/1890	20/1870	22/1845	24/1815	26/1790	28/1765	30/1740	32/1715	34/1690	36/1665	661
2	603	2/2070	0/2070	2/2050	4/2015	6/1990	8/1960	10/1930	12/1905	14/1880	16/1855	18/1830	20/1805	22/1775	24/1750	26/1725	28/1700	30/1675	32/1655	34/1630	663
3	604	4/2020	2/2020	0/2005	2/1970	4/1950	6/1920	8/1890	10/1865	12/1840	14/1815	16/1790	18/1765	20/1740	22/1715	24/1690	26 1665	28/1645	30/1620	32/1600	664
4	606	6/1975	4/1975	2/1965	0/1930	2/1905	4/1880	6/1850	8/1825	10/1800	12/1775	14/1750	16/1730	18/1705	20/1680	22/1655	24/1630	26/1610	28/1585	30/1565	666
5	607	8/1935	6/1935	4/1920	2/1890	0/1865	2/1840	4/1810	6/1785	8/1760	10/1740	12/1715	14/1690	16/1665	18/1645	20/1620	22/1595	24/1575	26/1550	28/1530	667
6	609	10/1890	8/1890	6/1880	4/1850	2/1820	0/1800	2/1770	4/1750	6/1725	8/1700	10/1675	12/1655	14/1630	16/1605	18/1580	20/1560	22/1540	24/1515	26/1495	669
7	610	12/1865	10/1845	8/1835	6/1810	4/1780	2/1760	0/1730	2/1710	4/1685	6/1665	8/1640	10/1620	12/1595	14/1570	16/1545	18/1530	20/1505	22/1485	24/1465	670
8	612	14/1805	12/1805	10/1795	8/1770	6/1740	4/1720	2/1695	0/1670	2/1650	4/1625	6/1605	8/1580	10/1560	12/1535	14/1510	16/1495	18/1470	20/1450	22/1430	672
9	613	16/1765	14/1765	12/1755	10/1725	8/1705	6/1680	4/1660	2/1635	0/1610	2/1590	4/1570	6/1545	8/1525	10/1500	12/1480	14/1460	16/1440	18/1420	20/1400	673
10	615	18/1725	16/1725	14/1715	12/1685	10/1665	8/1640	6/1620	4/1600	2/1575	0/1555	2/1535	4/1510	6/1495	8/1465	10/1445	12/1425	14/1405	16/1385	18/1365	675
11	646	20/1685	18/1685	16/1675	14/1650	12/1625	10/1600	8/1580	6/1560	4/1540	2/1520	0/1495	2/1475	4/1455	6/1440	8/1410	10/1395	12/1370	14/1355	16/1335	676
12	618	22/1645	20/1650	18/1640	16/1610	14/1590	12/1570	10/1545	8/1520	6/1480	4/1480	2/1460	0/1440	2/1420	4/1400	6/1380	8/1360	10/1340	12/1320	14/1300	678
13	619	24/1610	22/1610	20/1600	18/1575	16/1550	14/1530	12/1510	10/1485	8/1470	6/1450	4/1430	2/1410	0/1390	2/1365	4/1345	6/1330	8/1310	10/1290	12/1270	679
14	621	26/1570	24/1570	22/1560	20/1540	18/1515	16/1495	14/1475	12/1450	10/1435	8/1415	6/1390	4/1375	2/1355	0/1330	2/1315	4/1295	6/1280	8/1260	10/1240	681
15	622	28/1540	26/1540	24/1525	22/1500	20/1480	18/1460	16/1440	14/1420	12/1400	10/1380	8/1360	6/1340	4/1320	2/1300	0/1280	2/1265	4/1245	6/1230	8/1210	682
16	624	30/1505	28/1505	26/1490	24/1465	22/1445	20/1425	18/1405	16/1385	14/1365	12/1345	10/1325	8/1305	6/1290	4/1270	2/1250	0/1235	2/1215	4/1200	6/1185	684
17	625	32/1470	30/1470	28/1440	26/1430	24/1410	22/1390	20/1370	18/1350	16/1330	14/1315	12/1295	10/1275	8/1255	6/1240	4/1220	2/1205	0/1185	2/1170	4/1155	685
18	627	34/1430	32/1430	30/1415	28/1395	26/1375	24/1355	22/1335	20/1320	18/1300	16/1280	14/1265	12/1245	10/1225	8/1210	6/1190	4/1175	2/1155	0/1140	2/1125	687
19	628	36/1395	34/1395	32/1375	30/1355	28/1335	26/1320	24/1300	22/1285	20 1265	18/1250	16/1230	14/1215	12/1195	10/1180	8/1160	6/1145	4/1130	2/1115	0/1100	688
20	630	38/1365	36/1360	34/1340	32/1320	30/1305	28/1285	26/1270	24/1250	22/1235	20/1220	18/1205	16/1185	14/1170	12/1150	10/1135	8/1120	6/1105	4/1085	2/1070	690
21	631	40/1330	38/1330	36/1310	34/1290	32/1270	30/1255	28/1240	26/1220	24/1205	22/1190	20/1175	18/1155	16/1140	14/1125	12/1105	10/1090	8/1075	6/1060	4/1045	691
22	633	42/1300	40/1295	38/1275	36/1260	34/1240	32/1225	30/1210	28/1190	26/1175	24/1160	22/1145	20/1125	18/1110	16/1095	14/1080	12/1060	10/1050	8/1030	6/1015	693
23	634	44/1265	42/1250	40/1240	38/1225	36/1205	34/1190	32/1175	30/1160	28/1145	26/1130	24/1115	22/1100	20/1080	18/1065	16/1050	14/1035	12/1020	10/1005	8/990	694
24	636	46/1230	44/1220	42/1205	40/1190	38/1170	36/1160	34/1145	32/1130	30/1115	28/1100	26/1085	24/1070	22/1055	20/1040	18/1025	16/1010	14/995	12/980	10/965	696
25	637	48/1200	46/1190	44/1170	42/1155	40/1140	38/1125	36/1110	34/1095	32/1080	30/1070	28/1055	26/1040	24/1030	22/1015	20/995	18/985	16/970	14/955	12/945	697
26	639	50/1170	48/1155	46/1140	44/1125	42/1110	40/1095	38/1080	36/1065	34/1055	32/1040	30/1025	28/1015	26/1000	24/985	22/970	20/960	18/945	16/930	14/920	699
27	640	52/1130	50/1120	48/1105	46/1095	44/1080	42/1065	40/1050	38/1040	36/1030	34/1015	32/1000	30/985	28/975	26/960	24/945	22/935	20/920	18/910	16/895	700
28	642	54/1100	52/1090	50/1075	48/1060	46/1050	44/1035	42/1020	40/1010	38/1000	36/985	34/975	32/960	30/945	28/935	26/920	24/910	22/895	20/885	18/870	702
29	643	56/1070	54/1055	52/1045	50/1030	48/1020	46/1005	44/995	42/980	40/970	38/960	36/945	34/920	32/930	30/910	28/895	26/885	24/870	22/860	20/845	703
30	645	58/1035	56/1025	54/1010	52/1000	50/985	48/975	46/965	44/950	42/940	40/930	38/920	36/910	34/895	32/885	30/870	28/860	26/850	24/835	22/825	705

† MOD.1426

NOTES 1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE

2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

* PRE-MOD.1426

TYNE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITHOUT ANTI-ICING

160 Kts. IAS

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW lb. per hour																			• MAX TGT °C.
0	600	10/2165	12/2165	14/2150	16/2120	18/2090	20/2060	22/2030	24/2000	26/1970	28/1940	30/1915	32/1890	34/1860	36/1830	38/1805	40/1780	42/1750	44/1725	46/1700	660
1	601	8/2125	10/2125	12/2100	14/2070	16/2045	18/2015	20/1990	22/1960	24/1930	26/1900	28/1880	30/1850	32/1820	34/1795	36/1770	38/1745	40/1720	42/1695	44/1670	661
2	603	6/2075	8/2075	10/2055	12/2030	14/2000	16/1970	18/1945	20/1920	22/1890	24/1860	26/1840	28/1810	30/1785	32/1760	34/1735	36/1710	38/1685	40/1660	42/1640	663
3	604	4/2030	6/2030	8/2010	10/1985	12/1955	14/1930	16/1900	18/1875	20/1850	22/1820	24/1800	26/1770	28/1750	30/1720	32/1700	34/1670	36/1650	38/1625	40/1605	664
4	606	2/1985	4/1985	6/1970	8/1945	10/1910	12/1890	14/1860	16/1835	18/1810	20/1785	22/1760	24/1740	26/1710	28/1685	30/1665	32/1635	34/1615	36/1595	38/1570	666
5	607	0/1940	2/1940	4/1930	6/1900	8/1870	10/1850	12/1820	14/1795	16/1770	18/1750	20/1720	22/1700	24/1670	26/1650	28/1625	30/1600	32/1580	34/1560	36/1540	667
6	609	2/1895	0/1895	2/1885	4/1860	6/1830	8/1810	10/1780	12/1755	14/1730	16/1710	18/1680	20/1660	22/1635	24/1610	26/1590	28/1570	30/1545	32/1525	34/1505	669
7	610	4/1850	2/1850	0/1845	2/1820	4/1790	6/1770	8/1740	10/1720	12/1690	14/1670	16/1645	18/1620	20/1600	22/1575	24/1555	26/1535	28/1510	30/1490	32/1470	670
8	612	6/1810	4/1810	2/1800	0/1780	2/1750	4/1730	6/1700	8/1680	10/1655	12/1630	14/1610	16/1585	18/1565	20/1540	22/1520	24/1500	26/1475	28/1455	30/1435	672
9	613	8/1770	6/1770	4/1760	2/1740	0/1710	2/1690	4/1665	6/1640	8/1620	10/1595	12/1575	14/1550	16/1530	18/1510	20/1485	22/1465	24/1445	26/1425	28/1400	673
10	615	10/1730	8/1730	6/1720	4/1700	2/1675	0/1650	2/1620	4/1605	6/1580	8/1560	10/1540	12/1515	14/1495	16/1475	18/1450	20/1430	22/1410	24/1390	26/1370	675
11	616	12/1690	10/1690	8/1680	6/1660	4/1640	2/1610	0/1590	2/1570	4/1545	6/1525	8/1505	10/1480	12/1460	14/1440	16/1420	18/1400	20/1380	22/1360	24/1340	676
12	618	14/1650	12/1650	10/1645	8/1620	6/1600	4/1575	2/1550	0/1530	2/1510	4/1490	6/1470	8/1450	10/1430	12/1410	14/1390	16/1370	18/1350	20/1330	22/1310	678
13	619	16/1615	14/1615	12/1605	10/1585	8/1560	6/1540	4/1520	2/1500	0/1475	2/1455	4/1435	6/1415	8/1395	10/1375	12/1360	14/1340	16/1320	18/1300	20/1280	679
14	621	18/1580	16/1580	14/1570	12/1550	10/1525	8/1505	6/1485	4/1465	2/1440	0/1420	2/1400	4/1380	6/1365	8/1340	10/1325	12/1305	14/1285	16/1270	18/1250	681
15	622	20/1545	18/1545	16/1535	14/1515	12/1490	10/1470	8/1450	6/1430	4/1410	2/1390	0/1370	2/1350	4/1330	6/1310	8/1295	10/1275	12/1255	14/1240	16/1220	682
16	624	22/1505	20/1505	18/1495	16/1475	14/1455	12/1435	10/1415	8/1395	6/1375	4/1355	2/1340	0/1320	2/1300	4/1280	6/1260	8/1245	10/1225	12/1210	14/1190	684
17	625	24/1475	22/1475	20/1460	18/1440	16/1420	14/1400	12/1380	10/1360	8/1340	6/1320	4/1305	2/1285	0/1270	2/1250	4/1230	6/1215	8/1195	10/1180	12/1160	685
18	627	26/1440	24/1440	22/1425	20/1405	18/1390	16/1365	14/1350	12/1330	10/1310	8/1290	6/1270	4/1250	2/1240	0/1220	2/1200	4/1185	6/1170	8/1150	10/1135	687
19	628	28/1405	26/1405	24/1390	22/1370	20/1355	18/1330	16/1315	14/1295	12/1280	10/1260	8/1240	6/1220	4/1210	2/1190	0/1170	2/1155	4/1140	6/1120	8/1110	688
20	630	30/1370	28/1370	26/1355	24/1335	22/1320	20/1300	18/1280	16/1265	14/1245	12/1230	10/1210	8/1195	6/1180	4/1160	2/1145	0/1130	2/1110	4/1095	6/1085	690
21	631	32/1340	30/1335	28/1320	26/1300	24/1285	22/1265	20/1250	18/1230	16/1215	14/1200	12/1180	10/1165	8/1150	6/1130	4/1120	2/1100	0/1085	2/1070	4/1060	691
22	633	34/1305	32/1300	30/1285	28/1270	26/1250	24/1230	22/1220	20/1200	18/1185	16/1170	14/1150	12/1135	10/1120	8/1105	6/1090	4/1070	2/1060	0/1045	2/1030	693
23	634	36/1275	34/1270	32/1250	30/1235	28/1220	26/1200	24/1185	22/1170	20/1155	18/1140	16/1120	14/1110	12/1090	10/1080	8/1060	6/1045	4/1035	2/1020	0/1005	694
24	636	38/1240	36/1230	34/1215	32/1200	30/1185	28/1170	26/1150	24/1140	22/1125	20/1110	18/1090	16/1080	14/1065	12/1050	10/1035	8/1020	6/1010	4/995	2/980	696
25	637	40/1210	38/1200	36/1185	34/1170	32/1155	30/1140	28/1125	26/1110	24/1100	22/1080	20/1065	18/1050	16/1040	14/1025	12/1010	10/995	8/980	6/970	4/955	697
26	639	42/1180	40/1170	38/1155	36/1140	34/1125	32/1110	30/1095	28/1080	26/1070	24/1050	22/1040	20/1025	18/1010	16/995	14/985	12/970	10/955	8/945	6/930	699
27	640	44/1150	42/1135	40/1120	38/1110	36/1095	34/1080	32/1065	30/1050	28/1040	26/1025	24/1010	22/1000	20/985	18/970	16/960	14/940	12/930	10/920	8/905	700
28	642	46/1115	44/1100	42/1090	40/1075	38/1065	36/1050	34/1035	32/1020	30/1010	28/1000	26/985	24/970	22/960	20/945	18/930	16/920	14/905	12/895	10/880	702
29	643	48/1080	46/1070	44/1060	42/1045	40/1035	38/1020	36/1005	34/995	32/985	30/970	28/960	26/945	24/935	22/920	20/905	18/895	16/880	14/870	12/860	703
30	645	50/1045	48/1035	46/1025	44/1015	42/1005	40/990	38/980	36/965	34/955	32/940	30/930	28/920	26/905	24/895	22/880	20/870	18/860	16/850	14/835	705

† MOD.1426

NOTES: 1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE

2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT-HAND COLUMN

• PRE-MOD.1426

TYNE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITH ANTI-ICING

160 Kts. I.A.S.

PRESSURE ALTITUDE x 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW - lb. per hour																			* MAX TGT °C.
0	600	2/2165	4/2165	6/2150	8/2120	10/2090	12/2060	14/2030	16/2000	18/1970	20/1940	22/1915	24/1890	26/1860	28/1830	30/1805	32/1780	34/1750	36/1725	38/1700	660
1	601	0/2125	2/2125	4/2100	6/2070	8/2045	10/2015	12/1990	14/1960	16/1930	18/1900	20/1880	22/1850	24/1820	26/1795	28/1770	30/1745	32/1720	34/1695	36/1670	661
2	603	2/2075	0/2075	2/2055	4/2030	6/2000	8/1970	10/1945	12/1920	14/1890	16/1860	18/1840	20/1810	22/1785	24/1760	26/1735	28/1710	30/1685	32/1660	34/1640	663
3	604	4/2030	2/2030	0/2010	2/1985	4/1955	6/1930	8/1900	10/1875	12/1850	14/1820	16/1800	18/1770	20/1750	22/1720	24/1700	26/1670	28/1650	30/1625	32/1605	664
4	606	6/1985	4/1985	2/1970	0/1945	2/1910	4/1890	6/1860	8/1835	10/1810	12/1785	14/1760	16/1740	18/1710	20/1685	22/1665	24/1635	26/1615	28/1595	30/1570	666
5	607	8/1940	6/1940	4/1930	2/1900	0/1870	2/1850	4/1820	6/1795	8/1770	10/1750	12/1720	14/1700	16/1670	18/1650	20/1625	22/1600	24/1580	26/1560	28/1540	667
6	609	10/1895	8/1895	6/1885	4/1860	2/1830	0/1810	2/1780	4/1755	6/1730	8/1710	10/1680	12/1660	14/1635	16/1610	18/1590	20/1570	22/1545	24/1525	26/1505	669
7	610	12/1850	10/1850	8/1845	6/1820	4/1790	2/1770	0/1740	2/1720	4/1690	6/1670	8/1645	10/1620	12/1600	14/1575	16/1555	18/1535	20/1510	22/1490	24/1470	670
8	612	14/1810	12/1810	10/1800	8/1780	6/1750	4/1730	2/1700	0/1680	2/1655	4/1630	6/1610	8/1585	10/1565	12/1540	14/1520	16/1500	18/1475	20/1455	22/1435	672
9	613	16/1770	14/1770	12/1760	10/1740	8/1710	6/1690	4/1665	2/1640	0/1620	2/1595	4/1575	6/1550	8/1530	10/1510	12/1485	14/1465	16/1445	18/1425	20/1400	673
10	615	18/1730	16/1730	14/1720	12/1700	10/1675	8/1650	6/1620	4/1605	2/1580	0/1560	2/1540	4/1515	6/1495	8/1475	10/1450	12/1430	14/1410	16/1390	18/1370	675
11	616	20/1690	18/1690	16/1680	14/1660	12/1640	10/1610	8/1590	6/1570	4/1545	2/1525	0/1505	2/1480	4/1460	6/1440	8/1420	10/1400	12/1380	14/1360	16/1340	676
12	618	22/1650	20/1650	18/1645	16/1620	14/1600	12/1575	10/1550	8/1530	6/1510	4/1490	2/1470	0/1450	2/1430	4/1410	6/1390	8/1370	10/1350	12/1330	14/1310	678
13	619	24/1615	22/1615	20/1605	18/1585	16/1560	14/1540	12/1520	10/1500	8/1475	6/1455	4/1435	2/1415	0/1395	2/1375	4/1360	6/1340	8/1320	10/1300	12/1280	679
14	621	26/1580	24/1580	22/1570	20/1550	18/1525	16/1505	14/1485	12/1465	10/1440	8/1420	6/1400	4/1380	2/1365	0/1340	2/1325	4/1305	6/1285	8/1270	10/1250	681
15	622	28/1545	26/1545	24/1535	22/1515	20/1490	18/1470	16/1450	14/1430	12/1410	10/1390	8/1370	6/1350	4/1330	2/1310	0/1295	2/1275	4/1255	6/1240	8/1220	682
16	624	30/1505	28/1505	26/1495	24/1475	22/1455	20/1435	18/1415	16/1395	14/1375	12/1355	10/1340	8/1320	6/1300	4/1280	2/1260	0/1245	2/1225	4/1210	6/1190	684
17	625	32/1475	30/1475	28/1460	26/1440	24/1420	22/1400	20/1380	18/1360	16/1340	14/1320	12/1305	10/1285	8/1270	6/1250	4/1230	2/1215	0/1195	2/1180	4/1160	685
18	627	34/1440	32/1440	30/1425	28/1405	26/1390	24/1365	22/1350	20/1330	18/1310	16/1290	14/1270	12/1250	10/1240	8/1220	6/1200	4/1185	2/1170	0/1150	2/1135	687
19	628	36/1405	34/1405	32/1390	30/1370	28/1355	26/1330	24/1315	22/1295	20/1280	18/1260	16/1240	14/1220	12/1210	10/1190	8/1170	6/1155	4/1140	2/1120	0/1110	688
20	630	38/1370	36/1370	34/1355	32/1335	30/1320	28/1300	26/1280	24/1265	22/1245	20/1230	18/1210	16/1195	14/1180	12/1160	10/1145	8/1130	6/1110	4/1095	2/1085	690
21	631	40/1340	38/1335	36/1320	34/1300	32/1285	30/1265	28/1250	26/1230	24/1215	22/1200	20/1180	18/1165	16/1150	14/1130	12/1120	10/1100	8/1085	6/1070	4/1060	691
22	633	42/1305	40/1300	38/1285	36/1270	34/1250	32/1230	30/1220	28/1200	26/1185	24/1170	22/1150	20/1135	18/1120	16/1105	14/1090	12/1070	10/1060	8/1045	6/1030	693
23	634	44/1275	42/1270	40/1250	38/1235	36/1220	34/1200	32/1185	30/1170	28/1155	26/1140	24/1120	22/1110	20/1090	18/1080	16/1060	14/1045	12/1035	10/1020	8/1005	694
24	636	46/1240	44/1230	42/1215	40/1200	38/1185	36/1170	34/1150	32/1140	30/1125	28/1110	26/1090	24/1080	22/1065	20/1050	18/1035	16/1020	14/1010	12/995	10/980	696
25	637	48/1210	46/1200	44/1185	42/1170	40/1155	38/1140	36/1125	34/1110	32/1100	30/1080	28/1065	26/1050	24/1040	22/1025	20/1010	18/995	16/980	14/970	12/955	697
26	639	50/1180	48/1170	46/1155	44/1140	42/1125	40/1110	38/1095	36/1080	34/1070	32/1050	30/1040	28/1025	26/1010	24/995	22/985	20/970	18/955	16/945	14/930	699
27	640	52/1150	50/1135	48/1120	46/1110	44/1095	42/1080	40/1065	38/1050	36/1040	34/1025	32/1010	30/1000	28/985	26/970	24/960	22/940	20/930	18/920	16/905	700
28	642	54/1115	52/1100	50/1090	48/1075	46/1065	44/1050	42/1035	40/1020	38/1010	36/1000	34/985	32/970	30/960	28/945	26/930	24/920	22/950	20/895	18/880	702
29	643	56/1080	54/1070	52/1060	50/1045	48/1035	46/1020	44/1005	42/995	40/985	38/970	36/960	34/945	32/935	30/920	28/905	26/895	24/880	22/870	20/860	703
30	645	58/1045	56/1035	54/1025	52/1015	50/1005	48/990	46/980	44/965	42/955	40/940	38/930	36/920	34/905	32/895	30/880	28/870	26/860	24/850	22/835	705

† MOD.1426

NOTES
1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE
2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT-HAND COLUMN

* PRE-MOD.1426

TYPE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITHOUT ANTI-ICING

170 Kts I.A.S.

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW lb. per hour																			* MAX TGT °C.
0	600	10/2165	12/2165	14/2155	16/2125	18/2095	20/2065	22/2035	24/2005	26/1980	28/1950	30/1920	32/1895	34/1870	36/1840	38/1815	40/1790	42/1765	44/1740	46/1715	660
1	601	8/2135	10/2135	12/2115	14/2085	16/2055	18/2025	20/1995	22/1965	24/1940	26/1910	28/1885	30/1855	32/1830	34/1805	36/1780	38/1755	40/1730	42/1705	44/1680	661
2	603	6/2090	8/2090	10/2070	12/2040	14/2015	16/1985	18/1955	20/1925	22/1900	24/1870	26/1845	28/1820	30/1795	32/1765	34/1745	36/1720	38/1690	40/1670	42/1645	663
3	604	4/2035	6/2035	8/2020	10/1995	12/1965	14/1940	16/1915	18/1885	20/1860	22/1835	24/1810	26/1780	28/1755	30/1730	32/1705	34/1685	36/1660	38/1635	40/1610	664
4	606	2/1995	4/1995	6/1980	8/1955	10/1925	12/1900	14/1875	16/1845	18/1820	20/1795	22/1770	24/1745	26/1720	28/1695	30/1670	32/1650	34/1625	36/1605	38/1580	666
5	607	0/1950	2/1950	4/1940	6/1915	8/1885	10/1860	12/1835	14/1810	16/1785	18/1760	20/1735	22/1710	24/1685	26/1660	28/1635	30/1615	32/1590	34/1570	36/1545	667
6	609	2/1905	0/1905	2/1900	4/1870	6/1845	8/1820	10/1795	12/1770	14/1745	16/1720	18/1695	20/1670	22/1645	24/1625	26/1605	28/1580	30/1555	32/1535	34/1510	669
7	610	4/1865	2/1865	0/1855	2/1830	4/1805	6/1780	8/1755	10/1730	12/1705	14/1685	16/1660	18/1635	20/1610	22/1590	24/1565	26/1545	28/1520	30/1500	32/1480	670
8	612	6/1820	4/1820	2/1815	0/1790	2/1765	4/1740	6/1715	8/1690	10/1665	12/1645	14/1620	16/1595	18/1575	20/1555	22/1530	24/1510	26/1490	28/1465	30/1445	672
9	613	8/1780	6/1780	4/1775	2/1750	0/1725	2/1700	4/1680	6/1655	8/1630	10/1605	12/1585	14/1560	16/1540	18/1520	20/1500	22/1475	24/1455	26/1435	28/1415	673
10	615	10/1740	8/1740	6/1735	4/1710	2/1685	0/1660	2/1640	4/1615	6/1595	8/1570	10/1550	12/1530	14/1505	16/1485	18/1465	20/1445	22/1425	24/1405	26/1380	675
11	616	12/1700	10/1700	8/1695	6/1670	4/1645	2/1625	0/1605	2/1580	4/1580	6/1535	8/1515	10/1495	12/1470	14/1455	16/1435	18/1415	20/1390	22/1375	24/1350	676
12	618	14/1660	12/1660	10/1655	8/1630	6/1610	4/1585	2/1565	0/1540	2/1520	4/1500	6/1480	8/1455	10/1440	12/1420	14/1400	16/1380	18/1260	20/1340	22/1320	678
13	619	16/1625	14/1625	12/1615	10/1595	8/1570	6/1550	4/1530	2/1505	0/1485	2/1465	4/1445	6/1425	8/1405	10/1385	12/1365	14/1350	16/1330	18/1310	20/1290	679
14	621	18/1585	16/1585	14/1580	12/1555	10/1535	8/1515	6/1490	4/1470	2/1450	0/1430	2/1410	4/1390	6/1375	8/1355	10/1335	12/1320	14/1300	16/1280	18/1260	681
15	622	20/1550	18/1550	16/1540	14/1520	12/1500	10/1480	8/1460	6/1435	4/1420	2/1400	0/1380	2/1360	4/1340	6/1325	8/1305	10/1285	12/1270	14/1250	16/1230	682
16	624	22/1515	20/1515	18/1505	16/1485	14/1465	12/1445	10/1425	8/1400	6/1385	4/1365	2/1345	0/1325	2/1310	4/1290	6/1275	8/1255	10/1240	12/1220	14/1205	684
17	625	24/1480	22/1480	20/1470	18/1450	16/1430	14/1410	12/1390	10/1370	8/1350	6/1335	4/1315	2/1295	0/1270	2/1260	4/1245	6/1230	8/1210	10/1190	12/1175	685
18	627	26/1445	24/1445	22/1435	20/1415	18/1395	16/1375	14/1355	12/1335	10/1320	4/1300	6/1280	4/1265	2/1250	0/1230	2/1215	4/1195	6/1180	8/1165	10/1145	687
19	628	28/1410	26/1410	24/1400	22/1380	20/1360	18/1340	16/1325	14/1305	12/1290	10/1270	8/1255	6/1235	4/1220	2/1200	0/1185	2/1170	4/1155	6/1140	8/1120	688
20	630	30/1380	28/1380	26/1365	24/1345	22/1330	20/1310	18/1290	16/1270	14/1255	12/1240	10/1220	8/1205	6/1190	4/1170	2/1155	0/1140	2/1125	4/1110	6/1090	690
21	631	32/1345	30/1345	28/1330	26/1315	24/1295	22/1280	20/1260	18/1240	16/1225	14/1210	12/1190	10/1175	8/1160	6/1145	4/1130	2/1115	0/1100	2/1080	4/1065	691
22	633	34/1315	32/1315	30/1300	28/1280	26/1265	24/1250	22/1230	20/1210	18/1195	16/1180	14/1160	12/1145	10/1130	8/1115	6/1100	4/1085	2/1070	0/1055	2/1040	693
23	634	36/1280	34/1280	32/1265	30/1250	28/1230	26/1215	24/1195	22/1180	20/1165	18/1150	16/1130	14/1115	12/1100	10/1085	8/1070	6/1055	4/1040	2/1025	0/1010	694
24	636	38/1245	36/1245	34/1230	32/1215	30/1195	28/1180	26/1165	24/1150	22/1135	20/1120	18/1105	16/1090	14/1075	12/1060	10/1045	8/1030	6/1015	4/1000	2/985	696
25	637	40/1215	38/1215	36/1195	34/1180	32/1165	30/1150	28/1135	26/1120	24/1105	22/1090	20/1075	18/1060	16/1045	14/1030	12/1020	10/1005	8/990	6/980	4/960	697
26	639	42/1180	40/1180	38/1160	36/1150	34/1135	32/1120	30/1105	28/1090	26/1075	24/1065	22/1050	20/1035	18/1020	16/1005	14/995	12/980	10/970	8/950	6/940	599
27	64C	44/1150	42/1150	40/1135	38/1120	36/1105	34/1090	32/1075	30/1060	28/1050	26/1035	24/1020	22/1010	20/995	18/980	16/970	14/955	12/940	10/930	8/915	700
28	542	46/1125	44/1120	42/1105	40/1090	38/1075	36/1065	34/1050	32/1035	30/1025	28/1010	26/995	24/980	22/970	20/955	18/945	16/930	14/920	12/905	10/890	702
29	643	48/1090	46/1085	44/1070	42/1060	40/1045	38/1035	36/1020	34/1005	32/995	30/980	28/970	26/955	24/945	22/930	20/920	18/910	16/895	14/880	12/870	703
30	645	50/1060	48/1055	46/1040	44/1030	42/1020	40/1005	38/990	36/980	34/970	32/960	30/945	28/935	26/920	24/910	22/895	20/885	18/870	16/860	14/850	705

† MOD.1426

* PRE-MOD.1426

NOTES 1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE

2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

TYNE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITH ANTI-ICING

170 Kts.I.A.S.

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C/FUEL FLOW - lb. per hour																			* MAX TGT °C.
0	600	2/2165	4/2165	6/2155	8/2125	10/2095	12/2065	14/2035	16/2005	18/1980	20/1950	22/1920	24/1895	26/1870	28/1840	30/1815	32/1790	34/1765	36/1740	38/1715	660
1	601	0/2135	2/2135	4/2115	6/2085	8/2055	10/2025	12/1995	14/1965	16/1940	18/1910	20/1885	22/1855	24/1830	26/1805	28/1780	30/1755	32/1730	34/1705	36/1680	661
2	603	2/2090	0/2090	2/2070	4/2040	6/2015	8/1985	10/1955	12/1925	14/1900	16/1870	18/1845	20/1820	22/1795	24/1765	26/1745	28/1720	30/1690	32/1670	34/1645	663
3	604	4/2035	2/2035	0/2020	2/1995	4/1965	6/1940	8/1915	10/1885	12/1860	14/1835	16/1810	18/1780	20/1755	22/1730	24/1705	26/1685	28/1660	30/1635	32/1610	664
4	606	6/1995	4/1995	2/1980	0/1955	2/1925	4/1900	6/1875	8/1845	10/1820	12/1795	14/1770	16/1745	18/1720	20/1695	22/1670	24/1650	26/1625	28/1605	30/1580	666
5	607	8/1950	6/1950	4/1940	2/1915	0/1885	2/1860	4/1835	6/1810	8/1785	10/1760	12/1735	14/1710	16/1685	18/1660	20/1635	22/1615	24/1590	26/1570	28/1545	667
6	609	10/1905	8/1905	6/1900	4/1870	2/1845	0/1820	2/1795	4/1770	6/1745	8/1720	10/1695	12/1670	14/1645	16/1625	18/1605	20/1580	22/1555	24/1535	26/1510	669
7	610	12/1865	10/1865	8/1855	6/1830	4/1805	2/1780	0/1755	2/1730	4/1705	6/1685	8/1660	10/1635	12/1610	14/1590	16/1565	18/1545	20/1520	22/1500	24/1480	670
8	612	14/1820	12/1820	10/1815	8/1790	6/1765	4/1740	2/1715	0/1690	2/1665	4/1645	6/1620	8/1595	10/1575	12/1555	14/1530	16/1510	18/1490	20/1465	22/1445	672
9	613	16/1780	14/1780	12/1775	10/1750	8/1725	6/1700	4/1680	2/1655	0/1630	2/1605	4/1585	6/1560	8/1540	10/1520	12/1500	14/1475	16/1455	18/1435	20/1415	673
10	615	18/1740	16/1740	14/1735	12/1710	10/1685	8/1660	6/1640	4/1615	2/1595	0/1570	2/1550	4/1530	6/1505	8/1485	10/1465	12/1445	14/1425	16/1405	18/1380	675
11	616	20/1700	18/1700	16/1695	14/1670	12/1645	10/1625	8/1605	6/1580	4/1560	2/1535	0/1515	2/1495	4/1470	6/1455	8/1435	10/1415	12/1390	14/1375	16/1350	676
12	618	22/1660	20/1660	18/1655	16/1630	14/1610	12/1585	10/1565	8/1540	6/1520	4/1500	2/1480	0/1455	2/1440	4/1420	6/1400	8/1380	10/1260	12/1340	14/1320	678
13	619	24/1625	22/1625	20/1615	18/1595	16/1570	14/1550	12/1530	10/1505	8/1485	6/1465	4/1445	2/1425	0/1405	2/1385	4/1365	6/1350	8/1330	10/1310	12/1290	679
14	621	26/1585	24/1585	22/1580	20/1555	18/1535	16/1515	14/1490	12/1470	10/1450	8/1430	6/1410	4/1390	2/1375	0/1355	2/1335	4/1320	6/1300	8/1280	10/1260	681
15	622	28/1550	26/1550	24/1540	22/1520	20/1500	18/1480	16/1460	14/1435	12/1420	10/1400	8/1380	6/1360	4/1340	2/1325	0/1305	2/1285	4/1270	6/1250	8/1230	682
16	624	30/1515	28/1515	26/1505	24/1485	22/1465	20/1445	18/1425	16/1400	14/1385	12/1365	10/1345	8/1325	6/1310	4/1290	2/1275	0/1255	2/1240	4/1220	6/1205	684
17	625	32/1480	30/1480	28/1470	26/1450	24/1430	22/1410	20/1390	18/1370	16/1350	14/1335	12/1315	10/1295	8/1270	6/1260	4/1245	2/1230	0/1210	2/1190	4/1175	685
18	627	34/1445	32/1445	30/1435	28/1415	26/1395	24/1375	22/1355	20/1335	18/1320	16/1300	14/1280	12/1265	10/1250	8/1230	6/1215	4/1195	2/1180	0/1165	2/1145	687
19	628	36/1410	34/1410	32/1400	30/1380	28/1360	26/1340	24/1325	22/1305	20/1290	18/1270	16/1255	14/1235	12/1220	10/1200	8/1185	6/1170	4/1155	2/1140	0/1120	688
20	630	38/1380	36/1380	34/1365	32/1345	30/1330	28/1310	26/1290	24/1270	22/1255	20/1240	18/1220	16/1205	14/1190	12/1170	10/1155	8/1140	6/1125	4/1110	2/1090	690
21	631	40/1345	38/1345	36/1330	34/1315	32/1295	30/1280	28/1260	26/1240	24/1225	22/1210	20/1190	18/1175	16/1160	14/1145	12/1130	10/1115	8/1100	6/1080	4/1065	691
22	633	42/1315	40/1315	38/1300	36/1280	34/1265	32/1250	30/1230	28/1210	26/1195	24/1180	22/1160	20/1145	18/1130	16/1115	14/1100	12/1085	10/1070	8/1055	6/1040	693
23	634	44/1280	42/1280	40/1265	38/1250	36/1230	34/1215	32/1195	30/1180	28/1165	26/1150	24/1130	22/1115	20/1100	18/1085	16/1070	14/1055	12/1040	10/1025	8/1010	694
24	636	46/1245	44/1245	42/1230	40/1215	38/1195	36/1180	34/1165	32/1150	30/1135	28/1120	26/1105	24/1090	22/1075	20/1060	18/1045	16/1030	14/1015	12/1000	10/985	696
25	637	48/1215	46/1215	44/1195	42/1180	40/1165	38/1150	36/1135	34/1120	32/1105	30/1090	28/1075	26/1060	24/1045	22/1030	20/1020	18/1005	16/990	14/980	12/960	697
26	639	50/1180	48/1180	46/1160	44/1150	42/1135	40/1120	38/1105	36/1090	34/1075	32/1065	30/1050	28/1035	26/1020	24/1005	22/995	20/980	18/970	16/950	14/940	699
27	640	52/1150	50/1150	48/1135	46/1120	44/1105	42/1090	40/1075	38/1060	36/1050	34/1035	32/1020	30/1010	28/995	26/980	24/970	22/955	20/940	18/930	16/915	700
28	642	54/1125	52/1120	50/1105	48/1090	46/1075	44/1065	42/1050	40/1035	38/1025	36/1010	34/995	32/980	30/970	28/955	26/945	24/930	22/920	20/905	18/890	702
29	643	56/1090	54/1085	52/1070	50/1060	48/1045	46/1035	44/1020	42/1005	40/995	38/980	36/970	34/955	32/945	30/930	28/920	26/910	24/895	22/880	20/870	703
30	645	58/1060	56/1055	54/1040	52/1030	50/1020	48/1005	46/990	44/980	42/970	40/960	38/945	36/935	34/920	32/910	30/895	28/885	26/870	24/860	22/850	705

† MOD.1426

NOTES
1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE
2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

* PRE-MOD 1426

TYNE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITHOUT ANTI-ICING

180 Kts IAS

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW lb. per hour																	• MAX TGT °C.
S.L.	600	10/2165	12/2165	14/2165	16/2135	18/2105	20/2075	22/2045	24/2015	26/1985	28/1960	30/1930	32/1900	34/1875	36/1850	38/1825	40/1800	42/1770	44/1750	46/1725	660
1	601	8/2140	10/2140	12/2120	14/2090	16/2060	18/2030	20/2000	22/1975	24/1945	26/1920	28/1890	30/1860	32/1840	34/1810	36/1785	38/1760	40/1735	42/1710	44/1685	661
2	603	6/2095	8/2095	10/2080	12/2050	14/2020	16/1990	18/1960	20/1935	22/1905	24/1880	26/1850	28/1825	30/1800	32/1775	34/1750	36/1725	38/1700	40/1675	42/1650	663
3	604	4/2045	6/2045	8/2030	10/2000	12/1975	14/1950	16/1920	18/1895	20/1870	22/1840	24/1810	26/1790	28/1765	30/1740	32/1715	34/1690	36/1670	38/1640	40/1620	664
4	606	2/2000	4/2000	6/1990	8/1960	10/1935	12/1910	14/1880	16/1850	18/1830	20/1800	22/1775	24/1750	26/1725	28/1700	30/1680	32/1655	34/1635	36/1610	38/1585	666
5	607	0/1955	2/1955	4/1950	6/1920	8/1895	10/1870	12/1840	14/1815	16/1790	18/1765	20/1740	22/1715	24/1690	26/1670	28/1645	30/1620	32/1600	34/1575	36/1555	667
6	609	2/1910	0/1910	2/1910	4/1880	6/1850	8/1830	10/1800	12/1775	14/1750	16/1730	18/1700	20/1680	22/1655	24/1635	26/1610	28/1590	30/1565	32/1540	34/1520	669
7	610	4/1870	2/1870	0/1870	2/1840	4/1810	6/1790	8/1760	10/1740	12/1715	14/1695	16/1665	18/1645	20/1620	22/1600	24/1575	26/1555	28/1530	30/1510	32/1490	670
8	612	6/1830	4/1830	2/1825	0/1800	2/1770	4/1750	6/1725	8/1700	10/1675	12/1655	14/1640	16/1605	18/1585	20/1560	22/1540	24/1520	26/1495	28/1475	30/1455	672
9	613	8/1785	6/1785	4/1785	2/1760	0/1730	2/1710	4/1685	6/1660	8/1640	10/1620	12/1595	14/1570	16/1550	18/1530	20/1510	22/1490	24/1465	26/1445	28/1425	673
10	615	10/1750	8/1750	6/1750	4/1720	2/1695	0/1670	2/1650	4/1625	6/1605	8/1580	10/1560	12/1540	14/1515	16/1495	18/1475	20/1455	22/1430	24/1415	26/1395	675
11	616	12/1705	10/1705	8/1705	6/1680	4/1660	2/1635	0/1615	2/1590	4/1570	6/1545	8/1525	10/1505	12/1480	14/1460	16/1440	18/1420	20/1400	22/1380	24/1360	676
12	618	14/1670	12/1670	10/1670	8/1645	6/1620	4/1600	2/1575	0/1555	2/1535	4/1510	6/1490	8/1470	10/1450	12/1430	14/1410	16/1390	18/1370	20/1350	22/1330	678
13	619	16/1630	14/1630	12/1630	10/1605	8/1580	6/1565	4/1540	2/1520	0/1500	2/1480	4/1460	6/1440	8/1420	10/1400	12/1380	14/1360	16/1340	18/1320	20/1300	679
14	621	18/1595	16/1595	14/1590	12/1570	10/1550	8/1530	6/1505	4/1485	2/1465	0/1445	2/1425	4/1405	6/1385	8/1365	10/1350	12/1330	14/1310	16/1290	18/1270	681
15	622	20/1560	18/1560	16/1555	14/1530	12/1510	10/1495	8/1470	6/1450	4/1430	2/1410	0/1390	2/1370	4/1350	6/1335	8/1320	10/1300	12/1280	14/1260	16/1240	682
16	624	22/1525	20/1525	18/1525	16/1500	14/1480	12/1460	10/1435	8/1415	6/1395	4/1380	2/1360	0/1340	2/1320	4/1305	6/1285	8/1270	10/1250	12/1230	14/1210	684
17	625	24/1490	22/1490	20/1485	18/1465	16/1445	14/1425	12/1405	10/1385	8/1365	6/1345	4/1325	2/1310	0/1290	2/1270	4/1255	6/1240	8/1220	10/1200	12/1180	685
18	627	26/1455	24/1455	22/1450	20/1430	18/1410	16/1390	14/1370	12/1350	10/1330	8/1315	6/1295	4/1280	2/1260	0/1240	2/1225	4/1210	6/1190	8/1170	10/1155	687
19	628	28/1420	26/1420	24/1415	22/1395	20/1375	18/1355	16/1340	14/1320	12/1300	10/1280	8/1265	6/1250	4/1230	2/1210	0/1195	2/1180	4/1160	6/1145	8/1130	688
20	630	30/1390	28/1390	26/1380	24/1360	22/1345	20/1325	18/1310	16/1290	14/1270	12/1250	10/1235	8/1220	6/1200	4/1180	2/1170	0/1155	2/1130	4/1120	6/1105	690
21	631	32/1355	30/1355	28/1345	26/1330	24/1310	22/1290	20/1275	18/1255	16/1240	14/1220	12/1205	10/1190	8/1170	6/1155	4/1140	2/1125	0/1105	2/1090	4/1080	691
22	633	34/1320	32/1320	30/1310	28/1295	26/1275	24/1260	22/1240	20/1220	18/1210	16/1190	14/1170	12/1160	10/1140	8/1125	6/1110	4/1095	2/1080	0/1065	2/1050	693
23	634	36/1290	34/1290	32/1280	30/1260	28/1245	26/1230	24/1210	22/1195	20/1180	18/1160	16/1145	14/1130	12/1115	10/1100	8/1085	6/1070	4/1055	2/1040	0/1025	694
24	636	38/1260	36/1260	34/1250	32/1220	30/1215	28/1200	26/1180	24/1165	22/1150	20/1130	18/1120	16/1100	14/1090	12/1075	10/1060	8/1045	6/1030	4/1015	2/1000	696
25	637	40/1225	38/1225	36/1215	34/1200	32/1180	30/1170	28/1150	26/1135	24/1120	22/1105	20/1090	18/1075	16/1060	14/1050	12/1030	10/1020	8/1005	6/990	4/975	697
26	639	42/1195	40/1195	38/1180	36/1165	34/1150	32/1135	30/1120	28/1105	26/1090	24/1080	22/1065	20/1050	18/1030	16/1020	14/1010	12/995	10/980	8/965	6/950	699
27	640	44/1160	42/1160	40/1150	38/1135	36/1120	34/1105	32/1090	30/1075	28/1060	26/1050	24/1035	22/1020	20/1005	18/995	16/980	14/970	12/955	10/940	8/930	700
28	642	46/1130	44/1130	42/1120	40/1105	38/1090	36/1075	34/1060	32/1050	30/1035	28/1020	26/1010	24/995	22/980	20/970	18/955	16/945	14/930	12/920	10/905	702
29	643	48/1105	46/1100	44/1085	42/1075	40/1060	38/1080	36/1035	34/1020	32/1010	30/995	28/980	26/970	24/960	22/945	20/930	18/920	16/905	14/895	12/880	703
30	645	50/1070	48/1065	46/1055	44/1045	42/1030	40/1020	38/1010	36/995	34/980	32/970	30/960	28/945	26/935	24/920	22/910	20/895	18/880	16/870	14/860	705

† MOD.1426

NOTES
1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE
2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT-HAND COLUMN

• PRE-MOD.1426

TYNE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K. WITH ANTI-ICING

180 Kts. I.A.S.

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW - lb. per hour																			* MAX TGT °C.
0	600	2/2165	4/2165	6/2165	8/2135	10/2105	12/2075	14/2045	16/2015	18/1985	20/1960	22/1930	24/1900	26/1875	28/1850	30/1825	32/1800	34/1770	36/1750	38/1725	660
1	601	0/2140	2/2140	4/2120	6/2090	8/2060	10/2030	12/2000	14/1975	16/1945	18/1920	20/1890	22/1860	24/1840	26/1810	28/1785	30/1760	32/1735	34/1710	36/1685	661
2	603	2/2095	0/2095	2/2080	4/2050	6/2020	8/1990	10/1960	12/1935	14/1905	16/1880	18/1850	20/1825	22/1800	24/1775	26/1750	28/1725	30/1700	32/1675	34/1650	663
3	604	4/2045	2/2045	0/2030	2/2000	4/1975	6/1950	8/1920	10/1895	12/1870	14/1840	16/1810	18/1790	20/1765	22/1740	24/1715	26/1690	28/1670	30/1640	32/1620	664
4	606	6/2000	4/2000	2/1990	0/1960	2/1935	4/1910	6/1880	8/1850	10/1830	12/1800	14/1775	16/1750	18/1725	20/1700	22/1680	24/1655	26/1635	28/1610	30/1585	666
5	607	8/1955	6/1955	4/1950	2/1920	0/1895	2/1870	4/1840	6/1815	8/1790	10/1765	12/1740	14/1715	16/1690	18/1670	20/1645	22/1620	24/1600	26/1575	28/1555	667
6	609	10/1910	8/1910	6/1910	4/1880	2/1850	0/1830	2/1800	4/1775	6/1750	8/1730	10/1700	12/1680	14/1655	16/1635	18/1610	20/1590	22/1565	24/1540	26/1520	669
7	610	12/1870	10/1870	8/1870	6/1840	4/1810	2/1790	0/1760	2/1740	4/1715	6/1695	8/1665	10/1645	12/1620	14/1600	16/1575	18/1555	20/1530	22/1510	24/1490	670
8	612	14/1830	12/1830	10/1825	8/1800	6/1770	4/1750	2/1725	0/1700	2/1675	4/1655	6/1640	8/1605	10/1585	12/1560	14/1540	16/1520	18/1495	20/1475	22/1455	672
9	613	16/1785	14/1785	12/1785	10/1760	8/1730	6/1710	4/1685	2/1660	0/1640	2/1620	4/1595	6/1570	8/1550	10/1530	12/1510	14/1490	16/1465	18/1445	20/1425	673
10	615	18/1750	16/1750	14/1750	12/1720	10/1695	8/1670	6/1650	4/1625	2/1605	0/1580	2/1560	4/1540	6/1515	8/1495	10/1475	12/1455	14/1430	16/1415	18/1395	675
11	616	20/1705	18/1705	16/1705	14/1680	12/1660	10/1635	8/1615	6/1590	4/1570	2/1545	0/1525	2/1505	4/1480	6/1460	8/1440	10/1420	12/1400	14/1380	16/1360	676
12	618	22/1670	20/1670	18/1670	16/1645	14/1620	12/1600	10/1575	8/1555	6/1535	4/1510	2/1490	0/1470	2/1450	4/1430	6/1410	8/1390	10/1370	12/1350	14/1330	678
13	619	24/1630	22/1630	20/1630	18/1605	16/1580	14/1565	12/1540	10/1520	8/1500	6/1480	4/1460	2/1440	0/1420	2/1400	4/1380	6/1360	8/1340	10/1320	12/1300	679
14	621	26/1585	24/1595	22/1590	20/1570	18/1550	16/1530	14/1505	12/1485	10/1465	8/1445	6/1425	4/1405	2/1385	0/1365	2/1350	4/1330	6/1310	8/1290	10/1270	681
15	622	28/1560	26/1560	24/1555	22/1530	20/1510	18/1495	16/1470	14/1450	12/1430	10/1410	8/1390	6/1370	4/1350	2/1335	0/1320	2/1300	4/1280	6/1260	8/1240	682
16	624	30/1525	28/1525	26/1525	24/1500	22/1480	20/1460	18/1435	16/1415	14/1395	12/1380	10/1360	8/1340	6/1320	4/1305	2/1285	0/1270	2/1250	4/1230	6/1210	684
17	625	32/1490	30/1490	28/1485	26/1465	24/1445	22/1425	20/1405	18/1385	16/1365	14/1345	12/1325	10/1310	8/1290	6/1270	4/1255	2/1240	0/1220	2/1200	4/1180	685
18	627	34/1455	32/1455	30/1450	28/1430	26/1410	24/1390	22/1370	20/1350	18/1330	16/1315	14/1295	12/1280	10/1260	8/1240	6/1225	4/1210	2/1190	0/1170	2/1155	687
19	628	36/1420	34/1420	32/1415	30/1395	28/1375	26/1355	24/1340	22/1320	20/1300	18/1280	16/1265	14/1250	12/1230	10/1210	8/1195	6/1180	4/1160	2/1145	0/1130	688
20	630	38/1390	36/1390	34/1380	32/1360	30/1345	28/1325	26/1310	24/1290	22/1270	20/1250	18/1235	16/1220	14/1200	12/1180	10/1170	8/1155	6/1130	4/1120	2/1105	690
21	631	40/1355	38/1355	36/1345	34/1330	32/1310	30/1290	28/1275	26/1255	24/1240	22/1220	20/1205	18/1190	16/1170	14/1155	12/1140	10/1125	8/1105	6/1090	4/1080	691
22	633	42/1320	40/1320	38/1310	36/1295	34/1275	32/1260	30/1240	28/1220	26/1210	24/1190	22/1170	20/1160	18/1140	16/1125	14/1110	12/1095	10/1080	8/1065	6/1050	693
23	634	44/1290	42/1290	40/1280	38/1260	36/1245	34/1230	32/1210	30/1195	26/1160	26/1160	24/1145	22/1130	20/1115	18/1100	16/1085	14/1070	12/1055	10/1040	8/1025	694
24	636	46/1260	44/1260	42/1250	40/1220	38/1215	36/1200	34/1180	32/1165	30/1150	28/1130	26/1120	24/1100	22/1090	20/1075	18/1060	16/1045	14/1030	12/1015	10/1000	696
25	637	48/1225	46/1225	44/1215	42/1200	40/1180	38/1170	36/1150	34/1135	32/1120	30/1105	28/1090	26/1075	24/1060	22/1050	20/1030	18/1020	16/1005	14/990	12/975	697
26	639	50/1195	48/1195	46/1180	44/1165	42/1150	40/1135	38/1120	36/1105	34/1090	32/1080	30/1065	28/1050	26/1030	24/1020	22/1010	20/995	18/980	16/965	14/950	699
27	640	52/1160	50/1160	48/1150	46/1135	44/1120	42/1105	40/1090	38/1075	36/1060	34/1050	32/1035	30/1020	28/1005	26/995	24/980	22/970	20/955	18/940	16/930	700
28	642	54/1130	52/1130	50/1120	48/1105	46/1090	44/1075	42/1060	40/1050	38/1035	36/1020	34/1010	32/995	30/980	28/970	26/955	24/945	22/930	20/920	18/905	702
29	643	56/1105	54/1100	52/1085	50/1075	48/1060	46/1050	44/1035	42/1020	40/1010	38/995	36/980	34/970	32/960	30/945	28/930	26/920	24/905	22/895	20/880	703
30	645	58/1070	56/1065	54/1055	52/1045	50/1030	48/1020	46/1010	44/995	42/980	40/970	38/960	36/945	34/935	32/920	30/910	28/895	26/880	24/870	22/860	705

† MOD.1426

NOTES 1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE

2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT-HAND COLUMN

* PRE-MOD.1426

TYNE MK 515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITHOUT ANTI-ICING

190 Kts I.A.S.

PRESSURE ALTITUDE x 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW lb. per hour																			* MAX TGT °C.
S.L.	600	10/2165	12/2165	14/2165	16/2145	18/2115	20/2085	22/2055	24/2025	26/1995	28/1965	30/1940	32/1910	34/1885	36/1860	38/1830	40/1805	42/1780	44/1755	46/1730	660
1	601	8/2150	10/2150	12/2130	14/2100	16/2070	18/2040	20/2010	22/1985	24/1955	26/1925	28/1900	30/1875	32/1850	34/1820	36/1795	38/1770	40/1745	42/1720	44/1695	661
2	603	6/2100	8/2100	10/2085	12/2060	14/2030	16/2000	18/1970	20/1945	22/1915	24/1890	26/1860	28/1835	30/1810	32/1785	34/1760	36/1735	38/1710	40/1685	42/1660	663
3	604	4/2050	6/2050	8/2045	10/2020	12/1990	14/1960	16/1930	18/1905	20/1875	22/1850	24/1820	26/1800	28/1770	30/1750	32/1725	34/1700	36/1675	38/1650	40/1630	664
4	606	2/2010	4/2010	6/2000	8/1980	10/1950	12/1920	14/1890	16/1865	18/1840	20/1810	22/1785	24/1760	26/1735	28/1715	30/1690	32/1665	34/1640	36/1615	38/1595	666
5	607	0/1965	2/1965	4/1960	6/1935	8/1905	10/1880	12/1850	14/1825	16/1800	18/1775	20/1750	22/1725	24/1700	26/1680	28/1655	30/1630	32/1605	34/1585	36/1560	667
6	609	2/1920	0/1920	2/1920	4/1890	6/1865	8/1840	10/1810	12/1790	14/1760	16/1740	18/1715	20/1690	22/1665	24/1645	26/1620	28/1595	30/1570	32/1550	34/1530	669
7	610	4/1875	2/1875	0/1875	2/1850	4/1825	6/1800	8/1775	10/1750	12/1725	14/1700	16/1680	18/1655	20/1630	22/1610	24/1585	26/1560	28/1540	30/1520	32/1500	670
8	612	6/1835	4/1835	2/1835	0/1810	2/1785	4/1760	6/1740	8/1710	10/1690	12/1665	14/1640	16/1620	18/1595	20/1570	22/1550	24/1530	26/1510	28/1485	30/1465	672
9	613	8/1800	6/1800	4/1800	2/1770	0/1750	2/1720	4/1700	6/1670	8/1650	10/1630	12/1605	14/1580	16/1560	18/1540	20/1515	22/1495	24/1475	26/1450	28/1430	673
10	615	10/1755	8/1755	6/1755	4/1740	2/1710	0/1685	2/1660	4/1640	6/1615	8/1595	10/1570	12/1550	14/1525	16/1505	18/1485	20/1460	22/1440	24/1420	26/1400	675
11	616	12/1715	10/1715	8/1715	6/1695	4/1670	2/1650	0/1625	2/1600	4/1580	6/1555	8/1535	10/1515	12/1490	14/1470	16/1450	18/1430	20/1410	22/1390	24/1370	676
12	618	14/1680	12/1680	10/1680	8/1660	6/1635	4/1610	2/1590	0/1565	2/1545	4/1520	6/1500	8/1480	10/1460	12/1440	14/1420	16/1400	18/1380	20/1360	22/1340	678
13	619	16/1640	14/1640	12/1640	10/1620	8/1600	6/1575	4/1530	2/1530	0/1510	2/1490	4/1465	6/1445	8/1425	10/1410	12/1390	14/1370	16/1350	18/1330	20/1310	679
14	621	18/1605	16/1605	14/1605	12/1585	10/1560	8/1540	6/1520	4/1495	2/1475	0/1455	2/1435	4/1415	6/1395	8/1375	10/1360	12/1340	14/1320	16/1300	18/1280	681
15	622	20/1565	18/1565	16/1565	14/1545	12/1525	10/1505	8/1485	6/1460	4/1440	2/1420	0/1400	2/1385	4/1360	6/1345	8/1325	10/1310	12/1290	14/1270	16/1255	682
16	624	22/1535	20/1535	18/1535	16/1510	14/1490	12/1470	10/1450	8/1430	6/1410	4/1390	2/1370	0/1350	2/1330	4/1315	6/1295	8/1280	10/1260	12/1240	14/1225	684
17	625	24/1500	22/1500	20/1500	18/1475	16/1455	14/1435	12/1415	10/1395	8/1380	6/1360	4/1340	2/1320	0/1300	2/1285	4/1265	6/1250	8/1230	10/1210	12/1195	685
18	627	26/1465	24/1465	22/1465	20/1440	18/1420	16/1400	14/1380	12/1360	10/1345	8/1325	6/1310	4/1290	2/1270	0/1255	2/1235	4/1220	6/1200	8/1185	10/1170	687
19	628	28/1430	26/1430	24/1425	22/1410	20/1390	18/1370	16/1350	14/1330	12/1310	10/1295	8/1280	6/1260	4/1240	2/1225	0/1210	2/1190	4/1170	6/1160	8/1140	688
20	630	30/1400	28/1400	26/1395	24/1375	22/1355	20/1340	18/1320	16/1300	14/1280	12/1265	10/1250	8/1230	6/1210	4/1195	2/1180	0/1160	2/1145	4/1130	6/1115	690
21	631	32/1365	30/1365	28/1360	26/1340	24/1320	22/1305	20/1290	18/1265	16/1250	14/1235	12/1220	10/1200	8/1180	6/1170	4/1150	2/1135	0/1120	2/1105	4/1090	691
22	633	34/1330	32/1330	30/1325	28/1310	26/1290	24/1270	22/1255	20/1235	18/1220	16/1205	14/1190	12/1170	10/1155	8/1140	6/1125	4/1110	2/1095	0/1080	2/1065	693
23	634	36/1300	34/1300	32/1290	30/1275	28/1260	26/1240	24/1225	22/1205	20/1190	18/1175	16/1160	14/1140	12/1120	10/1110	8/1100	6/1080	4/1070	2/1055	0/1040	694
24	636	38/1270	36/1270	34/1260	32/1245	30/1230	28/1210	26/1195	24/1180	22/1160	20/1150	18/1130	16/1115	14/1100	12/1085	10/1070	8/1055	6/1040	4/1025	2/1015	696
25	637	40/1235	38/1235	36/1225	34/1210	32/1195	30/1180	28/1160	26/1150	24/1130	22/1120	20/1100	18/1090	16/1070	14/1060	12/1045	10/1030	8/1015	6/1000	4/985	697
26	639	42/1205	40/1205	38/1195	36/1180	34/1165	32/1150	30/1130	28/1120	26/1105	24/1090	22/1075	20/1060	18/1045	16/1035	14/1020	12/1005	10/990	8/975	6/960	699
27	640	44/1175	42/1175	40/1160	38/1150	36/1135	34/1120	32/1105	30/1090	28/1080	26/1065	24/1050	22/1035	20/1020	18/1010	16/996	14/980	12/970	10/955	8/940	700
28	642	46/1145	44/1145	42/1130	40/1120	38/1105	36/1090	34/1080	32/1065	30/1050	28/1040	26/1025	24/1010	22/1000	20/985	18/970	16/960	14/945	12/930	10/920	702
29	643	48/1115	46/1115	44/1100	42/1090	40/1075	38/1055	36/1050	34/1040	32/1025	30/1010	28/1000	26/985	24/975	22/960	20/950	18/935	16/920	14/910	12/895	703
30	645	50/1085	48/1080	46/1070	44/1060	42/1045	40/1045	38/1025	36/1010	34/1000	32/985	30/970	28/960	26/950	24/935	22/920	20/910	18/900	16/885	14/870	705

† MOD.1426

* PRE-MOD.1426

NOTES 1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE

2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

TYNE MK 515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K.WITH ANTI-ICING

190 Kts I.A.S.

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW lb. per hour																			* MAX TGT °C.
0	600	2/2165	4/2165	6/2165	8/2145	10/2115	12/2085	14/2055	16/2025	18/1995	20/1965	22/1940	24/1910	26/1885	28/1860	30/1830	32/1805	34/1780	36/1755	38/1730	660
1	601	0/2150	2/2150	4/2130	6/2100	8/2070	10/2040	12/2010	14/1985	16/1955	18/1925	20/1900	22/1875	24/1850	26/1820	28/1795	30/1770	32/1745	34/1720	36/1695	661
2	603	2/2100	0/2100	2/2085	4/2060	6/2030	8/2000	10/1970	12/1945	14/1915	16/1890	18/1860	20/1835	22/1810	24/1785	26/1760	28/1735	30/1710	32/1685	34/1660	663
3	604	4/2050	2/2050	0/2045	2/2020	4/1990	6/1960	8/1930	10/1905	12/1875	14/1850	16/1820	18/1800	20/1770	22/1750	24/1725	26/1700	28/1675	30/1650	32/1630	664
4	606	6/2010	4/2010	2/2000	0/1980	2/1950	4/1920	6/1890	8/1865	10/1840	12/1810	14/1785	16/1760	18/1735	20/1715	22/1690	24/1665	26/1640	28/1615	30/1595	666
5	607	8/1965	6/1965	4/1960	2/1935	0/1905	2/1880	4/1850	6/1825	8/1800	10/1775	12/1750	14/1725	16/1700	18/1680	20/1655	22/1630	24/1605	26/1585	28/1560	667
6	609	10/1920	8/1920	6/1920	4/1890	2/1865	0/1840	2/1810	4/1790	6/1760	8/1740	10/1715	12/1690	14/1665	16/1645	18/1620	20/1595	22/1570	24/1550	26/1530	669
7	610	12/1875	10/1875	8/1875	6/1850	4/1825	2/1800	0/1775	2/1750	4/1725	6/1700	8/1680	10/1655	12/1630	14/1610	16/1585	18/1560	20/1540	22/1520	24/1500	670
8	612	14/1835	12/1835	10/1835	8/1810	6/1785	4/1760	2/1740	0/1710	2/1690	4/1665	6/1640	8/1620	10/1595	12/1570	14/1550	16/1530	18/1510	20/1485	22/1465	672
9	613	16/1800	14/1800	12/1800	10/1770	8/1750	6/1720	4/1700	2/1670	0/1650	2/1630	4/1605	6/1580	8/1560	10/1540	12/1515	14/1495	16/1475	18/1450	20/1430	673
10	615	18/1755	16/1755	14/1755	12/1740	10/1710	8/1685	6/1660	4/1640	2/1615	0/1595	2/1570	4/1550	6/1525	8/1505	10/1485	12/1460	14/1440	16/1420	18/1400	675
11	616	20/1715	18/1715	16/1715	14/1695	12/1670	10/1650	8/1625	6/1600	4/1580	2/1555	0/1535	2/1515	4/1490	6/1470	8/1450	10/1430	12/1410	14/1390	16/1370	676
12	618	22/1680	20/1680	18/1680	16/1660	14/1635	12/1610	10/1590	8/1565	6/1545	4/1520	2/1500	0/1480	2/1460	4/1440	6/1420	8/1400	10/1380	12/1360	14/1340	678
13	619	24/1640	22/1640	20/1640	18/1620	16/1600	14/1575	12/1530	10/1530	8/1510	6/1490	4/1465	2/1445	0/1425	2/1410	4/1390	6/1370	8/1350	10/1330	12/1310	679
14	621	26/1605	24/1605	22/1605	20/1585	18/1560	16/1640	14/1520	12/1495	10/1475	8/1455	6/1435	4/1415	2/1395	0/1375	2/1360	4/1340	6/1320	8/1300	10/1280	681
15	622	28/1565	26/1565	24/1565	22/1545	20/1525	18/1505	16/1485	14/1460	12/1440	10/1420	8/1400	6/1385	4/1360	2/1345	0/1325	2/1310	4/1290	6/1270	8/1255	682
16	624	30/1535	28/1535	26/1535	24/1510	22/1490	20/1470	18/1450	16/1430	14/1410	12/1390	10/1370	8/1350	6/1330	4/1315	2/1295	0/1280	2/1260	4/1240	6/1225	684
17	625	32/1500	30/1500	28/1500	26/1475	24/1455	22/1435	20/1415	18/1395	16/1380	14/1360	12/1340	10/1320	8/1300	6/1285	4/1265	2/1250	0/1230	2/1210	4/1195	685
18	627	34/1465	32/1465	30/1465	28/1440	26/1420	24/1400	22/1380	20/1360	18/1345	16/1325	14/1310	12/1290	10/1270	8/1255	6/1235	4/1220	2/1200	0/1185	2/1170	687
19	628	36/1430	34/1430	32/1425	30/1410	28/1390	26/1370	24/1350	22/1330	20/1310	18/1295	16/1280	14/1260	12/1240	10/1225	8/1210	6/1190	4/1170	2/1160	0/1140	688
20	630	38/1400	36/1400	34/1395	32/1375	30/1355	28/1340	26/1320	24/1300	22/1280	20/1265	18/1250	16/1230	14/1210	12/1195	10/1180	8/1160	6/1145	4/1130	2/1115	690
21	631	40/1365	38/1365	36/1360	34/1340	32/1320	30/1305	28/1290	26/1265	24/1250	22/1235	20/1220	18/1200	16/1180	14/1170	12/1150	10/1135	8/1120	6/1105	4/1090	691
22	633	42/1330	40/1330	38/1325	36/1310	34/1290	32/1270	30/1255	28/1235	26/1220	24/1205	22/1190	20/1170	18/1155	16/1140	14/1125	12/1110	10/1095	8/1080	6/1065	693
23	634	44/1300	42/1300	40/1290	38/1275	36/1260	34/1240	32/1225	30/1205	28/1190	26/1175	24/1160	22/1140	20/1120	18/1110	16/1100	14/1080	12/1070	10/1055	8/1040	694
24	636	46/1270	44/1270	42/1260	40/1245	38/1230	36/1210	34/1195	/1180	30/1160	28/1150	26/1130	24/1115	22/1100	20/1085	18/1070	16/1055	14/1040	12/1025	10/1015	696
25	637	48/1235	46/1235	44/1225	42/1210	40/1195	38/1180	36/1160	/1150	32/1130	30/1120	28/1100	26/1090	24/1070	22/1060	20/1045	18/1030	16/1015	14/1000	12/985	697
26	639	50/1205	48/1205	46/1195	44/1180	42/1165	40/1150	38/1130	36/1120	34/1105	32/1090	30/1075	28/1060	26/1045	24/1035	22/1020	20/1005	18/990	16/975	14/960	699
27	640	52/1175	50/1175	48/1160	46/1150	44/1135	42/1120	40/1105	38/1090	36/1080	34/1065	32/1050	30/1035	28/1020	26/1010	24/996	22/980	20/970	18/955	16/940	700
28	642	54/1145	52/1145	50/1130	48/1120	46/1105	44/1090	42/1080	40/1065	38/1050	36/1040	34/1025	32/1010	30/1000	28/985	26/970	24/960	22/945	20/930	18/920	702
29	643	56/1115	54/1115	52/1100	50/1090	48/1075	46/1055	44/1050	42/1040	40/1025	38/1010	36/1000	34/985	32/975	30/960	28/950	26/935	24/920	22/910	20/895	703
30	645	58/1085	56/1080	54/1070	52/1060	50/1045	48/1045	46/1025	44/1010	42/1000	40/985	38/970	36/960	34/950	32/935	30/920	28/910	26/900	24/885	22/870	705

† MOD.1426

NOTES 1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE

2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

* PRE-MOD.1426

TYNE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K. WITHOUT HOT AIR ANTI-ICING

200 Kts I.A.S.

PRESSURE ALTITUDE X 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C./FUEL FLOW lb. per hour																			• MAX TGT °C.
S.L.	600	10/2165	12/2165	14/2165	16/2160	18/2130	20/2100	22/2070	24/2040	26/2010	28/1980	30/1955	32/1925	34/1895	36/1870	38/1845	40/1820	42/1790	44/1765	46/1740	660
1	601	8/2155	10/2155	12/2140	14/2110	16/2080	18/2055	20/2025	22/1995	24/1970	26/1940	28/1910	30/1885	32/1860	34/1830	36/1805	38/1780	40/1755	42/1730	44/1705	661
2	603	6/2110	8/2110	10/2100	12/2070	14/2045	16/2015	18/1985	20/1955	22/1930	24/1900	26/1875	28/1850	30/1825	32/1800	34/1775	36/1750	38/1725	40/1700	42/1675	663
3	604	4/2060	6/2060	8/2055	10/2026	12/2000	14/1970	16/1945	18/1915	20/1890	22/1860	24/1835	26/1810	28/1785	30/1760	32/1735	34/1710	36/1685	38/1665	40/1640	664
4	606	2/2015	4/2015	6/2010	8/1985	10/1960	12/1930	14/1905	16/1875	18/1850	20/1825	22/1800	24/1775	26/1750	28/1725	30/1700	32/1675	34/1650	36/1630	38/1605	666
5	607	0/1970	2/1970	4/1970	6/1945	8/1915	10/1890	12/1860	14/1835	16/1810	18/1785	20/1760	22/1735	24/1710	26/1685	28/1665	30/1640	32/1615	34/1595	36/1570	667
6	609	2/1930	0/1930	2/1930	4/1905	6/1880	8/1850	10/1825	12/1800	14/1770	16/1750	18/1725	20/1700	22/1680	24/1650	26/1630	28/1605	30/1580	32/1560	34/1540	669
7	610	4/1885	2/1885	0/1883	2/1865	4/1840	6/1815	8/1790	10/1760	12/1740	14/1715	16/1690	18/1665	20/1640	22/1620	24/1600	26/1575	28/1550	30/1530	32/1510	670
8	612	6/1845	4/1845	2/1845	0/1825	2/1800	4/1775	6/1750	8/1725	10/1700	12/1675	14/1655	16/1630	18/1605	20/1585	22/1565	24/1540	26/1520	28/1495	30/1475	672
9	613	8/1805	6/1805	4/1805	2/1785	0/1760	2/1735	4/1710	6/1685	8/1665	10/1640	12/1620	14/1595	16/1570	18/1550	20/1530	22/1510	24/1485	26/1465	28/1440	673
10	615	10/1765	8/1765	6/1765	4/1750	2/1725	0/1700	2/1675	4/1650	6/1630	8/1605	10/1585	12/1560	14/1540	16/1520	18/1495	22/1475	22/1450	24/1430	26/1410	675
11	616	12/1725	10/1725	8/1725	6/1710	4/1685	2/1660	0/1640	2/1615	4/1590	6/1570	8/1550	10/1525	12/1505	14/1480	16/1460	18/1440	20/1420	22/1400	24/1380	676
12	618	14/1690	12/1690	10/1690	8/1675	6/1650	4/1625	2/1605	0/1580	2/1560	4/1535	6/1515	8/1490	10/1470	12/1450	14/1430	16/1410	18/1390	20/1370	22/1350	678
13	619	16/1650	14/1650	12/1650	10/1635	8/1615	6/1590	4/1565	2/1545	0/1525	2/1500	4/1480	6/1460	8/1440	10/1420	12/1400	14/1380	16/1360	18/1340	20/1320	679
14	621	18/1615	16/1615	14/1615	12/1600	10/1575	8/1555	6/1530	4/1510	2/1490	0/1470	2/1450	4/1425	6/1405	8/1390	10/1365	12/1345	14/1330	16/1310	18/1290	681
15	622	20/1580	18/1580	16/1580	14/1565	12/1540	10/1520	8/1500	6/1475	4/1160	2/1435	0/1415	2/1395	4/1375	6/1355	8/1335	10/1320	12/1300	14/1280	16/1265	682
16	624	22/1545	20/1545	18/1545	16/1530	14/1505	12/1485	10/1465	8/1445	6/1425	4/1400	2/1385	0/1365	2/1345	4/1325	6/1310	8/1290	10/1270	12/1250	14/1235	684
17	625	24/1510	22/1510	20/1510	18/1490	16/1470	14/1450	12/1430	10/1410	8/1390	6/1370	4/1355	2/1335	0/1315	2/1295	4/1280	6/1260	8/1240	10/1225	12/1205	685
18	627	26/1475	24/1475	22/1475	20/1460	18/1440	16/1420	14/1400	12/1380	10/1360	8/1340	6/1320	4/1300	2/1280	0/1265	2/1250	4/1230	6/1210	8/1195	10/1180	687
19	628	28/1440	26/1440	24/1440	22/1425	20/1405	18/1385	16/1365	14/1350	12/1330	10/1310	8/1290	6/1270	4/1255	2/1235	0/1220	2/1200	4/1185	6/1170	8/1150	688
20	630	30/1410	28/1410	26/1410	24/1390	22/1370	20/1355	18/1335	16/1315	14/1295	12/1280	10/1260	8/1240	6/1225	4/1205	2/1190	0/1175	2/1160	4/1140	6/1125	690
21	631	32/1375	30/1375	28/1375	26/1355	24/1335	22/1320	20/1300	18/1285	16/1265	14/1250	12/1230	10/1215	8/1195	6/1180	4/1160	2/1150	0/1130	2/1115	4/1100	691
22	633	34/1345	32/1345	30/1340	28/1320	26/1305	24/1285	22/1270	20/1255	18/1235	16/1220	14/1200	12/1185	10/1170	8/1150	6/1135	4/1120	2/1105	0/1090	2/1075	693
23	634	36/1315	34/1315	32/1310	30/1290	28/1270	26/1255	24/1240	22/1225	20/1210	18/1190	16/1175	14/1160	12/1140	10/1125	8/1110	6/1095	4/1080	2/1065	0/1050	694
24	636	38/1285	36/1285	34/1275	32/1260	30/1245	28/1230	26/1210	24/1195	22/1180	20/1165	18/1145	16/1130	14/1115	12/1100	10/1085	3/1070	6/1055	4/1040	2/1025	696
25	637	40/1250	38/1250	36/1240	34/1230	32/1210	30/1195	28/1180	26/1165	24/1150	22/1135	20/1120	18/1105	16/1090	14/1075	12/1060	10/1045	8/1030	6/1015	4/1000	697
26	639	42/1220	40/1220	38/1210	36/1195	34/1180	32/1165	30/1150	28/1135	26/1120	24/1110	22/1090	20/1080	18/1065	16/1050	14/1035	12/1020	10/1005	8/990	6/980	699
27	640	44/1185	42/1185	40/1180	38/1165	36/1150	34/1135	32/1120	30/1110	28/1095	26/1080	24/1065	22/1050	20/1040	18/1025	16/1010	14/995	12/980	10/970	8/955	700
28	642	46/1160	44/1160	42/1150	40/1135	38/1120	36/1110	34/1090	32/1080	30/1065	28/1050	26/1040	24/1025	22/1010	20/995	18/985	16/970	14/955	12/945	10/930	702
29	643	48/1125	46/1125	44/1115	42/1105	40/1090	38/1080	36/1065	34/1055	32/1040	30/1025	28/1015	26/1000	24/990	22/975	20/960	18/950	16/935	14/925	12/910	703
30	645	50/1095	48/1095	46/1090	44/1080	42/1065	40/1065	38/1040	36/1025	34/1015	32/1000	30/990	28/975	26/965	24/950	22/940	20/925	18/910	16/900	14/885	705

† MOD.1426

NOTES
1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE
2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

• PRE-MOD.1426

TYNE MK.515 - FUEL FLOW CONTROL TABLE

CLIMB AT 88.3% (13500) L.P. R.P.M. AND 1164°K. WITH HOT AIR ANTI-ICING

200 Kts.I.A.S.

PRESSURE ALTITUDE x 1000'	† MAX TGT °C.	INDICATED AIR TEMPERATURE deg.C/FUEL FLOW lb. per hour																			* MAX TGT °C.
0	600	2/2165	4/2165	6/2165	8/2160	10/2130	12/2100	14/2070	16/2040	18/2010	20/1980	22/1955	24/1925	26/1895	28/1870	30/1845	32/1820	34/1790	36/1765	38/1740	660
1	601	0/2155	2/2155	4/2140	6/2110	8/2080	10/2055	12/2025	14/1995	16/1970	18/1940	20/1910	22/1885	24/1860	26/1830	28/1805	30/1780	32/1755	34/1730	36/1705	661
2	603	2/2110	0/2110	2/2100	4/2070	6/2045	8/2015	10/1985	12/1955	14/1930	16/1900	18/1875	20/1850	22/1825	24/1800	26/1775	28/1750	30/1725	32/1700	34/1675	663
3	604	4/2060	2/2060	0/2055	2/2025	4/2000	6/1970	8/1945	10/1915	12/1890	14/1860	16/1835	18/1810	20/1785	22/1760	24/1735	26/1710	28/1685	30/1665	32/1640	664
4	606	6/2015	4/2015	2/2010	0/1985	2/1960	4/1930	6/1905	8/1875	10/1850	12/1825	14/1800	16/1775	18/1750	20/1725	22/1700	24/1675	26/1650	28/1630	30/1605	666
5	607	8/1970	6/1970	4/1970	2/1945	0/1915	2/1890	4/1860	6/1835	8/1810	10/1785	12/1760	14/1735	16/1710	18/1685	20/1665	22/1640	24/1615	26/1595	28/1570	667
6	609	10/1930	8/1930	6/1930	4/1905	2/1880	0/1850	2/1825	4/1800	6/1770	8/1750	10/1725	12/1700	14/1680	16/1650	18/1630	20/1605	22/1580	24/1560	26/1540	669
7	610	12/1885	10/1885	8/1885	6/1865	4/1840	2/1815	0/1790	2/1760	4/1740	6/1715	8/1690	10/1665	12/1640	14/1620	16/1600	18/1575	20/1550	22/1530	24/1510	670
8	612	14/1845	12/1845	10/1845	8/1825	6/1800	4/1775	2/1750	0/1725	2/1700	4/1675	6/1655	8/1630	10/1605	12/1585	14/1565	16/1540	18/1520	20/1495	22/1475	672
9	613	16/1805	14/1805	12/1805	10/1785	8/1760	6/1735	4/1710	2/1685	0/1665	2/1640	4/1620	6/1595	8/1570	10/1550	12/1530	14/1510	16/1485	18/1465	20/1440	673
10	615	18/1765	16/1765	14/1765	12/1750	10/1725	8/1700	6/1675	4/1650	2/1630	0/1605	2/1585	4/1560	6/1540	8/1520	10/1495	12/1475	14/1450	16/1430	18/1410	675
11	616	20/1725	18/1725	16/1725	14/1710	12/1685	10/1660	8/1640	6/1615	4/1590	2/1570	0/1550	2/1525	4/1505	6/1480	8/1460	10/1440	12/1420	14/1400	16/1380	676
12	618	22/1690	20/1690	18/1690	16/1675	14/1650	12/1625	10/1605	8/1580	6/1560	4/1535	2/1515	0/1490	2/1470	4/1450	6/1430	8/1410	10/1390	12/1370	14/1350	678
13	619	24/1650	22/1650	20/1650	18/1635	16/1615	14/1590	12/1565	10/1545	8/1525	6/1500	4/1480	2/1460	0/1440	2/1420	4/1400	6/1380	8/1360	10/1340	12/1320	679
14	621	26/1615	24/1615	22/1615	20/1600	18/1575	16/1555	14/1530	12/1510	10/1490	8/1470	6/1450	4/1425	2/1405	0/1390	2/1365	4/1345	6/1330	8/1310	10/1290	681
15	622	28/1580	26/1580	24/1580	22/1565	20/1540	18/1520	16/1500	14/1475	12/1460	10/1435	8/1415	6/1395	4/1375	2/1355	0/1335	2/1320	4/1300	6/1280	8/1265	682
16	624	30/1545	28/1545	26/1545	24/1530	22/1505	20/1485	18/1465	16/1445	14/1425	12/1400	10/1385	8/1365	6/1345	4/1325	2/1310	0/1290	2/1270	4/1250	6/1235	684
17	625	32/1510	30/1510	28/1510	26/1490	24/1470	22/1450	20/1430	18/1410	16/1390	14/1370	12/1355	10/1335	8/1315	6/1295	4/1280	2/1260	0/1240	2/1225	4/1205	685
18	627	34/1475	32/1475	30/1475	28/1460	26/1440	24/1420	22/1400	20/1380	18/1360	16/1340	14/1320	12/1300	10/1280	8/1265	6/1250	4/1230	2/1210	0/1195	2/1180	687
19	628	36/1440	34/1440	32/1440	30/1425	28/1405	26/1385	24/1365	22/1350	20/1330	18/1310	16/1290	14/1270	12/1255	10/1235	8/1220	6/1200	4/1185	2/1170	0/1150	688
20	630	38/1410	36/1410	34/1410	32/1390	30/1370	28/1355	26/1335	24/1315	22/1295	20/1280	18/1260	16/1240	14/1225	12/1205	10/1190	8/1175	6/1160	4/1140	2/1125	690
21	631	40/1375	38/1375	36/1375	34/1355	32/1335	30/1320	28/1300	26/1285	24/1265	22/1250	20/1230	18/1215	16/1195	14/1180	12/1160	10/1150	8/1130	6/1115	4/1100	691
22	633	42/1345	40/1345	38/1340	36/1320	34/1305	32/1285	30/1270	28/1255	26/1235	24/1220	22/1200	20/1185	18/1170	16/1150	14/1135	12/1120	10/1105	8/1090	6/1075	693
23	634	44/1315	42/1315	40/1310	38/1290	36/1270	34/1255	32/1240	30/1225	28/1210	26/1190	24/1175	22/1160	20/1140	18/1125	16/1110	14/1095	12/1080	10/1065	8/1050	694
24	636	46/1285	44/1285	42/1275	40/1260	38/1245	36/1230	34/1210	32/1195	30/1180	28/1165	26/1145	24/1130	22/1115	20/1100	18/1085	16/1070	14/1055	12/1040	10/1025	696
25	637	48/1250	46/1250	44/1240	42/1230	40/1210	38/1195	36/1180	34/1165	32/1150	30/1135	28/1120	26/1105	24/1090	22/1075	20/1060	18/1045	16/1030	14/1015	12/1000	697
26	639	50/1220	48/1220	46/1210	44/1195	42/1180	40/1165	38/1150	36/1135	34/1120	32/1110	30/1090	28/1080	26/1065	24/1050	22/1035	20/1020	18/1005	16/990	14/980	699
27	640	52/1185	50/1185	48/1180	46/1165	44/1150	42/1135	40/1120	38/1110	36/1095	34/1080	32/1065	30/1050	28/1040	26/1025	24/1010	22/995	20/980	18/970	16/955	700
28	642	54/1160	52/1160	50/1150	48/1135	46/1120	44/1110	42/1090	40/1080	38/1065	36/1050	34/1040	32/1025	30/1010	28/995	26/985	24/970	22/955	20/945	18/930	702
29	643	56/1125	54/1125	52/1115	50/1105	48/1090	46/1080	44/1065	42/1055	40/1040	38/1025	36/1015	34/1000	32/990	30/975	28/960	26/950	24/935	22/925	20/910	703
30	645	58/1095	56/1095	54/1090	52/1080	50/1065	48/1065	46/1040	44/1025	42/1015	40/1000	38/990	36/975	34/965	32/950	30/940	28/925	26/910	24/900	22/885	705

† MOD.1426

NOTES
1) ALL TEMPERATURES BELOW THE STEPPED LINE ARE NEGATIVE
2) FOR AIR TEMPERATURES LESS THAN THOSE QUOTED, USE MAXIMUM FUEL FLOW IN LEFT HAND COLUMN

* PRE-MOD.1426

TYNE MK.515 - FUEL FLOW CONTROL TABLE - CRUISE AT 88.3% (13,500) L.P. R.P.M. AND 1164°K.

4 000 FEET ALTITUDE - T.G.T. LIMIT 666 DEGREES C. PRE-MOD.1426 - 606 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46
200	2015	2010	1980	1955	1930	1900	1875	1850	1820	1795	1770	1750	1720	1700	1675	1650	1625	1605	1580	1560	1540
210	2025	2020	1995	1965	1940	1910	1885	1860	1835	1810	1780	1755	1730	1710	1680	1660	1635	1610	1590	1565	1545
220	2030	2030	2005	1980	1950	1925	1895	1870	1845	1820	1725	1770	1745	1720	1695	1670	1645	1620	1600	1580	1555
230	2040	2040	2020	1990	1965	1935	1905	1880	1855	1830	1800	1775	1750	1725	1700	1680	1655	1630	1610	1585	1565
240	2050	2050	2035	2005	1980	1950	1920	1895	1870	1840	1815	1790	1765	1740	1715	1690	1665	1645	1620	1595	1575
250	2060	2060	2045	2020	1990	1960	1935	1910	1880	1855	1830	1800	1775	1750	1725	1700	1680	1655	1630	1605	1585
260	2070	2070	2065	2035	2005	1980	1950	1920	1895	1870	1840	1815	1790	1765	1740	1715	1690	1665	1645	1620	16
270	2080	2080	2075	2050	2020	1990	1960	1935	1905	1880	1850	1825	1800	1775	1750	1725	1700	1675	1650	1630	1610
280	2090	2090	2090	2060	2035	2005	1975	1950	1920	1895	1870	1840	1815	1790	1765	1740	1715	1690	1665	1640	1620
	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

5,000 FEET ALTITUDE - T.G.T. LIMIT 667 DEGREES C. PRE-MOD.1426 - 607 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44
200	1970	1940	1910	1885	1860	1835	1810	1785	1760	1735	1710	1685	1660	1640	1615	1595	1570	1550	1525	1505	
210	1980	1955	1930	1900	1875	1850	1825	1795	1775	1750	1725	1700	1675	1650	1630	1605	1585	1560	1540	1515	
220	1990	1970	1940	1915	1890	1860	1835	1810	1785	1760	1735	1710	1685	1665	1640	1615	1595	1570	1550	1525	
230	1995	1980	1950	1925	1900	1870	1845	1820	1795	1770	1745	1720	1695	1675	1650	1625	1605	1580	1560	1535	
240	2005	1995	1965	1940	1915	1885	1860	1835	1810	1785	1760	1735	1705	1685	1660	1635	1610	1590	1565	1545	
250	2015	2005	1980	1955	1925	1900	1870	1845	1820	1795	1770	1745	1720	1695	1670	1645	1625	1600	1580	1555	1530
260	2030	2030	2000	1975	1945	1915	1890	1860	1835	1810	1780	1755	1730	1705	1680	1665	1635	1610	1590	1570	1545
270	2035	2035	2005	1980	1950	1925	1900	1870	1845	1820	1795	1770	1745	1720	1695	1670	1650	1625	1600	1580	1555
280	2050	2050	2025	2000	1970	1940	1910	1885	1860	1835	1805	1780	1755	1730	1705	1680	1655	1635	1610	1590	1565
	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

6,000 FEET ALTITUDE - T.G.T. LIMIT 669 DEGREES C. PRE-MOD.1426 - 609 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
200	1930	1905	1875	1850	1825	1795	1770	1750	1725	1700	1675	1650	1630	1605	1585	1560	1540	1515	1495	1475	
210	1935	1915	1885	1860	1835	1810	1785	1760	1735	1710	1685	1660	1640	1615	1595	1570	1550	1525	1505	1485	
220	1945	1925	1900	1875	1850	1820	1795	1770	1745	1725	1695	1675	1650	1625	1605	1580	1560	1535	1515	1495	
230	1955	1940	1910	1885	1860	1835	1810	1785	1760	1735	1710	1685	1660	1640	1615	1590	1570	1545	1525	1505	
240	1965	1955	1925	1900	1875	1850	1825	1795	1775	1750	1725	1700	1675	1650	1625	1605	1580	1560	1535	1515	
250	1975	1965	1940	1915	1885	1860	1835	1810	1785	1760	1735	1710	1685	1660	1640	1615	1590	1570	1545	1525	1500
260	1990	1990	1965	1935	1905	1880	1855	1825	1800	1775	1750	1725	1700	1675	1650	1625	1605	1580	1555	1535	1515
270	1995	1995	1970	1940	1915	1885	1860	1835	1810	1785	1760	1735	1710	1685	1660	1635	1615	1590	1570	1550	1525
280	2010	2010	1985	1960	1930	1905	1875	1850	1825	1800	1770	1750	1725	1700	1675	1650	1630	1605	1580	1560	1535
	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

7,000 FEET ALTITUDE - T.G.T. LIMIT 670 DEGREES C. PRE-MOD.1426 - 610 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
200	1885	1860	1835	1810	1785	1760	1735	1710	1685	1665	1640	1620	1595	1570	1550	1530	1505	1485	1465	1445	
210	1895	1875	1850	1825	1800	1775	1750	1725	1700	1675	1650	1630	1605	1580	1560	1540	1515	1495	1475	1450	
220	1900	1885	1860	1835	1810	1785	1760	1735	1710	1685	1665	1640	1615	1595	1570	1550	1525	1505	1485	1450	
230	1910	1900	1875	1850	1820	1795	1770	1745	1720	1700	1675	1650	1625	1605	1580	1560	1535	1515	1495	1475	
240	1925	1920	1890	1865	1835	1810	1785	1760	1735	1710	1685	1660	1640	1615	1590	1570	1545	1525	1500	1480	1460
250	1935	1930	1905	1880	1850	1825	1800	1775	1750	1725	1700	1675	1650	1630	1605	1580	1560	1535	1515	1495	1475
260	1945	1945	1920	1890	1865	1840	1815	1790	1760	1740	1715	1690	1665	1640	1620	1595	1570	1550	1530	1505	1485
270	1955	1955	1935	1905	1880	1855	1825	1800	1775	1750	1725	1700	1675	1655	1630	1605	1595	1560	1540	1515	1495
280	1965	1965	1950	1920	1895	1870	1845	1815	1790	1765	1740	1715	1690	1670	1645	1620	1600	1575	1550	1530	1510
	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

TYNE MK 515 - FUEL FLOW CONTROL TABLE - CRUISE AT 88.3% (13500) L.P. R.P.M. AND 1164 K.

8,000 FEET ALTITUDE - T.G.T. LIMIT 672 DEGREES C. PRE-MOD 1426 - 612 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
KNOTS	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
200	1845	1825	1800	1770	1745	1720	1700	1675	1650	1625	1605	1580	1560	1535	1515	1495	1475	1450	1430	1410	
210	1855	1835	1810	1785	1760	1735	1710	1685	1660	1640	1615	1590	1570	1545	1525	1500	1480	1460	1440	1420	
220	1860	1850	1820	1795	1770	1745	1720	1695	1670	1650	1625	1605	1580	1555	1535	1510	1490	1470	1450	1430	
230	1870	1860	1835	1810	1785	1760	1735	1710	1685	1660	1640	1615	1590	1570	1550	1525	1505	1485	1460	1445	1425
240	1880	1875	1850	1825	1800	1775	1750	1725	1700	1675	1650	1630	1605	1580	1560	1530	1515	1495	1470	1450	1435
250	1895	1895	1865	1840	1815	1790	1765	1735	1715	1690	1665	1640	1620	1595	1570	1550	1530	1505	1485	1460	1440
260	1900	1900	1880	1855	1825	1800	1775	1750	1725	1700	1675	1655	1630	1605	1585	1560	1540	1515	1495	1475	1455
270	1910	1910	1895	1870	1845	1815	1790	1765	1740	1715	1690	1670	1645	1620	1600	1575	1550	1530	1510	1485	1465
280	1925	1925	1910	1885	1860	1830	1805	1780	1755	1730	1705	1685	1660	1635	1610	1590	1565	1545	1520	1500	1480
	-10	-8	-6	-4	-2	-0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

9,000 FEET ALTITUDE - T.G.T. LIMIT 673 DEGREES C. PRE-MOD.1426 - 613 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
KNOTS	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
200	1800	1785	1760	1735	1710	1685	1660	1640	1615	1595	1570	1550	1525	1505	1485	1460	1440	1425	1400	1385	
210	1815	1800	1775	1750	1725	1700	1675	1655	1630	1605	1585	1560	1540	1515	1495	1470	1450	1430	1410	1395	
220	1820	1810	1785	1760	1735	1710	1685	1665	1640	1620	1595	1570	1550	1530	1505	1485	1465	1445	1420	1405	1385
230	1830	1825	1800	1775	1750	1725	1700	1675	1655	1630	1605	1585	1560	1540	1520	1495	1475	1455	1435	1415	1395
240	1840	1840	1815	1790	1765	1740	1715	1690	1665	1640	1620	1595	1570	1550	1525	1505	1485	1465	1440	1420	1400
250	1855	1855	1830	1805	1780	1755	1730	1705	1680	1655	1635	1610	1590	1565	1540	1500	1500	1475	1445	1435	1410
260	1865	1865	1845	1820	1790	1765	1740	1720	1695	1670	1645	1620	1600	1575	1555	1530	1510	1490	1465	1445	1425
270	1875	1875	1860	1835	1810	1780	1755	1730	1705	1680	1660	1635	1610	1590	1565	1540	1520	1500	1475	1455	1435
280	1885	1885	1880	1850	1825	1800	1775	1750	1725	1700	1675	1650	1630	1605	1580	1560	1540	1515	1495	1475	1450
	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

10,000 FEET ALTITUDE - T.G.T. LIMIT 675 DEGREES C. PRE-MOD.1426 - 615 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
KNOTS	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
200	1765	1745	1720	1700	1675	1650	1625	1605	1580	1560	1535	1515	1495	1470	1450	1430	1410	1390	1370	1350	
210	1770	1760	1735	1710	1685	1665	1640	1615	1585	1570	1550	1525	1505	1485	1460	1440	1420	1400	1380	1360	
220	1780	1770	1745	1725	1700	1675	1650	1630	1605	1580	1560	1540	1515	1495	1475	1455	1430	1410	1390	1370	1355
230	1795	1790	1760	1740	1715	1690	1665	1640	1620	1595	1570	1550	1530	1505	1485	1460	1440	1420	1400	1380	1360
240	1800	1800	1775	1750	1725	1700	1680	1655	1630	1605	1585	1560	1540	1520	1495	1475	1450	1430	1410	1390	1370
250	1815	1815	1790	1765	1740	1715	1695	1670	1645	1620	1600	1575	1550	1530	1510	1485	1465	1445	1425	1405	1385
260	1825	1825	1805	1780	1755	1730	1705	1680	1660	1635	1610	1590	1565	1545	1520	1500	1480	1455	1435	1415	1395
270	1835	1835	1820	1795	1770	1745	1720	1695	1670	1650	1625	1600	1580	1555	1535	1510	1490	1470	1450	1430	1410
280	1845	1845	1840	1815	1790	1765	1740	1715	1690	1665	1640	1620	1595	1575	1550	1530	1505	1485	1465	1440	1420
	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

11,000 FEET ALTITUDE - T.G.T. LIMIT 676 DEGREES C. PRE-MOD.1426 - 616 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
KNOTS	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
200	1725	1710	1685	1660	1640	1615	1590	1570	1545	1525	1505	1480	1460	1440	1420	1400	1380	1360	1340	1325	
210	1735	1725	1700	1675	1655	1630	1605	1585	1560	1540	1520	1495	1475	1455	1435	1415	1395	1370	1355	1335	
220	1745	1735	1710	1685	1665	1640	1620	1595	1575	1550	1530	1505	1485	1465	1445	1425	1405	1385	1360	1345	1325
230	1755	1755	1725	1705	1680	1665	1630	1610	1585	1565	1540	1520	1495	1475	1455	1435	1415	1390	1375	1355	1340
240	1765	1765	1740	1715	1695	1670	1645	1625	1600	1575	1555	1530	1510	1485	1465	1445	1425	1405	1385	1365	1345
250	1775	1775	1755	1730	1705	1685	1660	1635	1615	1590	1570	1545	1525	1505	1480	1460	1440	1420	1400	1380	1360
260	1785	1785	1770	1745	1725	1700	1675	1650	1625	1605	1580	1560	1535	1515	1495	1470	1450	1430	1410	1390	1370
270	1795	1795	1785	1765	1740	1715	1690	1665	1640	1620	1595	1575	1550	1530	1510	1485	1465	1445	1420	1400	1380
280	1810	1810	1805	1780	1755	1730	1705	1680	1660	1635	1610	1590	1565	1545	1525	1500	1480	1455	1435	1415	1395
	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

TYNE MK.515 - FUEL FLOW CONTROL TABLE - CRUISE AT 88.3% (13500) L.P. R.P.M. AND 1164°K.

12,000 FEET ALTITUDE - T.G.T. LIMIT 678 DEGREES C. PRE-MOD.1426 - 618 DEGREES C. MOD 1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																				
	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
200	1690	1670	1650	1625	1605	1580	1555	1535	1510	1490	1470	1450	1425	1405	1385	1365	1350	1330	1310	1295	
210	1695	1685	1660	1640	1615	1595	1570	1550	1525	1505	1485	1465	1440	1420	1400	1380	1360	1340	1320	1305	1285
220	1705	1700	1675	1650	1630	1605	1585	1560	1540	1515	1495	1475	1455	1450	1410	1390	1370	1350	1330	1315	1295
230	1715	1715	1690	1665	1640	1620	1595	1575	1550	1530	1510	1485	1465	1445	1425	1405	1380	1360	1345	1325	1310
240	1725	1725	1705	1680	1655	1635	1610	1585	1565	1540	1520	1500	1480	1460	1435	1415	1395	1375	1355	1340	1320
250	1735	1735	1720	1695	1670	1650	1625	1600	1580	1555	1535	1515	1490	1470	1450	1430	1405	1890	1370	1350	1330
260	1750	1750	1735	1710	1685	1665	1640	1615	1595	1570	1550	1530	1505	1485	1465	1440	1420	1400	1380	1360	1340
270	1760	1760	1755	1730	1700	1680	1655	1630	1605	1585	1560	1540	1520	1495	1475	1450	1430	1410	1390	1370	1355
280	1770	1770	1770	1745	1720	1695	1670	1650	1625	1600	1580	1560	1535	1515	1490	1470	1450	1430	1405	1385	1365
	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																				

13,000 FEET ALTITUDE - T.G.T. LIMIT 679 DEGREES C. PRE-MOD.1426 - 619 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
200	1650	1635	1610	1590	1565	1545	1525	1500	1480	1460	1440	1420	1400	1380	1360	1340	1325	1305	1285	1270		
210	1660	1650	1625	1605	1580	1560	1535	1515	1495	1475	1450	1430	1410	1390	1370	1350	1330	1310	1295	1275	1260	
220	1665	1660	1640	1615	1595	1570	1550	1530	1505	1485	1465	1445	1425	1405	1380	1360	1345	1325	1305	1285	1270	
230	1680	1675	1655	1630	1610	1585	1560	1540	1520	1495	1475	1455	1435	1415	1395	1375	1355	1335	1315	1300	1280	
240	1690	1690	1670	1645	1620	1600	1575	1555	1535	1510	1490	1470	1450	1425	1405	1385	1370	1345	1325	1310	1290	
250	1700	1700	1685	1660	1635	1615	1590	1570	1545	1525	1505	1480	1460	1440	1420	1400	1380	1360	1340	1320	1300	
260	1710	1710	1700	1675	1655	1630	1605	1585	1560	1540	1520	1500	1475	1455	1435	1415	1395	1375	1355	1335	1320	
270	1720	1720	1715	1695	1670	1645	1620	1600	1575	1555	1530	1510	1490	1465	1445	1425	1405	1385	1365	1345	1330	
280	1735	1735	1735	1715	1690	1665	1640	1620	1595	1575	1550	1530	1505	1485	1465	1445	1420	1400	1380	1360	1340	
	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

14,000 FEET ALTITUDE - T.G.T. LIMIT 681 DEGREES C. PRE-MOD 1426 - 621 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28
200	1610	1600	1575	1555	1530	1510	1485	1465	1445	1425	1405	1385	1365	1343	1325	1305	1290	1270	1255	1240		
210	1620	1610	1590	1565	1545	1525	1500	1480	1460	1440	1415	1395	1380	1360	1340	1320	1300	1280	1265	1245	1230	
220	1630	1625	1600	1580	1555	1535	1515	1490	1470	1450	1430	1410	1390	1370	1350	1330	1310	1295	1275	1260	1240	
230	1640	1640	1620	1595	1570	1550	1525	1505	1485	1465	1440	1420	1400	1380	1360	1340	1320	1305	1285	1270	1250	
240	1650	1650	1630	1610	1585	1565	1540	1520	1500	1480	1455	1435	1415	1395	1375	1355	1355	1320	1300	1280	1260	
250	1665	1665	1650	1625	1600	1580	1555	1535	1515	1490	1470	1450	1430	1405	1385	1365	1345	1330	1310	1290	1270	1255
260	1675	1675	1665	1640	1620	1595	1575	1550	1530	1510	1485	1465	1445	1425	1405	1385	1365	1345	1325	1310	1290	1270
270	1685	1685	1685	1660	1635	1610	1585	1565	1540	1520	1500	1475	1455	1435	1415	1395	1375	1355	1335	1320	1300	1285
280	1700	1700	1700	1680	1655	1630	1605	1585	1560	1540	1520	1495	1475	1455	1435	1415	1390	1370	1350	1335	1315	1295
	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

15,000 FEET ALTITUDE - T.G.T. LIMIT 682 DEGREES C. PRE-MOD.1426 - 622 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26
200	1575	1560	1540	1520	1495	1475	1455	1435	1415	1395	1375	1355	1335	1315	1295	1280	1260	1245	1230	1210	1190	
210	1585	1575	1555	1530	1510	1490	1470	1450	1430	1410	1390	1370	1350	1330	1310	1290	1275	1255	1240	1225	1210	
220	1595	1590	1565	1535	1520	1500	1480	1460	1440	1420	1400	1380	1360	1340	1320	1300	1285	1265	1250	1230	1215	
230	1605	1605	1580	1560	1535	1515	1495	1470	1450	1430	1410	1390	1370	1350	1330	1310	1295	1275	1260	1240	1225	
240	1620	1620	1600	1575	1555	1530	1510	1490	1470	1445	1425	1405	1385	1365	1345	1330	1310	1290	1270	1255	1235	
250	1630	1630	1615	1595	1570	1550	1525	1505	1485	1465	1440	1420	1400	1380	1360	1340	1320	1300	1285	1265	1250	
260	1640	1640	1630	1605	1585	1560	1540	1520	1500	1475	1455	1435	1415	1395	1375	1355	1335	1315	1300	1280	1260	1245
270	1650	1650	1650	1630	1605	1580	1560	1535	1515	1490	1470	1450	1425	1405	1385	1365	1345	1325	1310	1290	1270	1255
280	1660	1660	1660	1656	1620	1600	1575	1555	1535	1510	1490	1470	1450	1430	1410	1390	1370	1350	1330	1310	1290	1270
	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING																					

TYNE MK.515 - FUEL FLOW CONTROL TABLE - CRUISE AT 88.3% (13500) L.P. R.P.M. AND 1164°K.

16,000 FEET ALTITUDE - T.G.T. LIMIT 684 DEGREES C. PRE-MOD.1426 - 624 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24
200	1540	1525	1505	1485	1460	1440	1420	1400	1380	1360	1345	1325	1305	1285	1270	1250	1230	1215	1200	1180	1160	
210	1550	1540	1520	1495	1475	1455	1435	1415	1395	1375	1355	1335	1315	1300	1280	1260	1240	1225	1210	1195	1175	
220	1560	1555	1530	1510	1490	1470	1450	1425	1405	1385	1365	1350	1330	1310	1290	1270	1255	1235	1220	1200	1185	
230	1570	1570	1550	1525	1505	1485	1460	1440	1420	1400	1380	1360	1340	1320	1305	1285	1265	1250	1230	1215	1200	
240	1580	1580	1565	1540	1520	1510	1475	1455	1435	1425	1395	1375	1355	1335	1315	1295	1280	1260	1245	1225	1210	
250	1595	1595	1580	1560	1535	1515	1495	1470	1450	1430	1410	1390	1370	1350	1335	1315	1295	1275	1255	1240	1215	
260	1605	1605	1595	1575	1550	1530	1510	1485	1465	1445	1425	1405	1385	1365	1345	1325	1310	1290	1270	1250	1235	1220
270	1615	1615	1615	1590	1570	1550	1525	1505	1485	1460	1440	1420	1400	1380	1360	1340	1325	1305	1285	1265	1250	1230
280	1630	1630	1630	1610	1590	1565	1545	1520	1500	1480	1460	1435	1415	1395	1375	1355	1335	1320	1300	1280	1260	1245
	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

17,000 FEET ALTITUDE - T.G.T. LIMIT 685 DEGREES C. PRE-MOD.1426 - 625 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22
200	1510	1490	1470	1450	1430	1410	1390	1370	1350	1330	1315	1295	1275	1260	1240	1220	1205	1190	1170	1155	1140	
210	1515	1505	1485	1465	1445	1425	1405	1385	1365	1345	1325	1305	1290	1270	1250	1235	1215	1200	1180	1165	1155	
220	1530	1525	1500	1480	1460	1440	1420	1400	1380	1360	1340	1320	1300	1280	1260	1245	1225	1210	1195	1180	1165	
230	1540	1540	1515	1495	1475	1450	1430	1410	1390	1370	1350	1330	1315	1295	1275	1260	1240	1220	1205	1190	1175	
240	1550	1550	1530	1510	1490	1470	1450	1425	1405	1385	1370	1350	1330	1310	1290	1270	1255	1235	1220	1200	1185	
250	1560	1560	1550	1525	1505	1485	1465	1445	1425	1400	1385	1365	1345	1325	1305	1290	1270	1250	1235	1215	1200	
260	1570	1570	1565	1540	1520	1500	1480	1460	1435	1415	1395	1375	1355	1340	1320	1300	1280	1260	1245	1225	1210	1195
270	1580	1580	1580	1560	1540	1520	1500	1475	1455	1435	1415	1395	1375	1355	1335	1320	1300	1280	1260	1245	1225	1210
280	1595	1595	1595	1580	1560	1535	1515	1495	1475	1455	1430	1410	1390	1370	1350	1335	1315	1295	1275	1260	1240	1220
	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

18,000 FEET ALTITUDE - T.G.T. LIMIT 687 DEGREES C. PRE-MOD,1426 - 627 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20
200	1475	1460	1440	1420	1400	1380	1360	1340	1320	1300	1280	1265	1245	1225	1210	1190	1175	1160	1145	1130	1110	
210	1485	1470	1450	1430	1410	1390	1370	1350	1330	1310	1295	1275	1255	1240	1220	1205	1185	1170	1155	1140	1125	
220	1495	1485	1465	1445	1425	1405	1385	1365	1345	1325	1305	1290	1270	1250	1230	1215	1200	1180	1165	1150	1135	
230	1505	1505	1480	1460	1440	1420	1400	1380	1360	1340	1320	1305	1285	1265	1245	1230	1215	1195	1180	1160	1150	
240	1515	1515	1500	1480	1455	1435	1415	1395	1375	1355	1335	1315	1300	1280	1260	1240	1225	1210	1190	1175	1160	
250	1525	1525	1515	1490	1470	1450	1430	1410	1390	1370	1350	1335	1315	1295	1275	1260	1240	1225	1205	1190	1175	
260	1540	1540	1530	1510	1490	1470	1450	1425	1405	1385	1365	1350	1330	1310	1290	1270	1255	1235	1220	1200	1185	1170
270	1550	1550	1550	1525	1505	1485	1465	1445	1425	1405	1385	1365	1350	1330	1310	1290	1270	1255	1235	1220	1200	1185
280	1565	1565	1565	1550	1525	1505	1485	1460	1440	1420	1400	1380	1360	1340	1320	1300	1285	1265	1250	1230	1215	1200
	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

19,000 FEET ALTITUDE - T.G.T. LIMIT 688 DEGREES C. PRE-MOD.1426 - 628 DEGREES C. MOD.1426

IAS KNOTS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18
200	1440	1420	1405	1385	1365	1345	1325	1305	1290	1270	1255	1235	1220	1200	1185	1165	1150	1135	1120	1105	1090	
210	1450	1440	1420	1400	1380	1360	1340	1325	1305	1285	1270	1250	1230	1215	1195	1180	1165	1145	1130	1115	1100	
220	1465	1455	1435	1415	1395	1375	1355	1335	1315	1295	1280	1260	1240	1225	1205	1190	1175	1155	1140	1125	1110	
230	1475	1475	1450	1430	1410	1390	1370	1350	1330	1310	1295	1275	1255	1240	1220	1200	1185	1170	1155	1140	1125	
240	1485	1485	1470	1450	1425	1405	1385	1370	1350	1330	1310	1290	1270	1255	1235	1215	1200	1185	1165	1150	1135	
250	1495	1495	1480	1460	1440	1420	1400	1380	1360	1345	1325	1305	1290	1270	1250	1235	1215	1200	1180	1165	1150	
260	1505	1505	1500	1480	1460	1440	1420	1400	1380	1360	1340	1320	1300	1285	1265	1245	1230	1215	1195	1180	1160	1145
270	1515	1515	1515	1495	1475	1455	1430	1415	1395	1380	1360	1340	1320	1300	1285	1265	1250	1230	1210	1195	1180	1160
280	1530	1530	1530	1520	1495	1475	1455	1435	1415	1395	1375	1355	1335	1320	1300	1280	1260	1240	1225	1210	1190	1175
	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

TYNE MK.515 - FUEL FLOW CONTROL TABLE - CRUISE AT 88.3% (13500) L.P. R.P.M. AND 1164°K.

20,000 FEET ALTITUDE - T.G.T. LIMIT 690 DEGREES C. PRE-MOD.1426 - 630 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
KNOTS	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16
200	1410	1390	1370	1350	1335	1315	1295	1275	1260	1240	1225	1205	1190	1170	1155	1140	1125	1110	1095	1080	1065	
210	1420	1405	1385	1370	1350	1330	1310	1290	1275	1255	1240	1220	1205	1185	1170	1150	1135	1120	1105	1090	1075	
220	1430	1420	1400	1380	1360	1345	1325	1305	1285	1270	1250	1230	1215	1195	1180	1160	1145	1130	1115	1100	1085	
230	1440	1440	1420	1400	1380	1360	1340	1320	1300	1285	1265	1245	1230	1210	1195	1175	1160	1145	1130	1115	1095	
240	1455	1455	1435	1415	1395	1375	1355	1335	1315	1300	1280	1260	1245	1225	1205	1190	1175	1155	1140	1125	1110	
250	1460	1460	1445	1425	1410	1390	1370	1350	1330	1310	1295	1275	1260	1240	1225	1205	1190	1170	1155	1140	1120	
260	1475	1475	1470	1450	1430	1410	1390	1370	1350	1330	1310	1290	1275	1255	1235	1220	1200	1185	1170	1155	1135	1125
270	1485	1485	1485	1465	1445	1425	1405	1485	1465	1345	1330	1310	1290	1275	1255	1235	1220	1220	1185	1170	1150	1135
280	1500	1500	1500	1490	1465	1445	1425	1405	1385	1365	1345	1325	1310	1290	1270	1250	1235	1215	1200	1180	1165	1150
	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

21,000 FEET ALTITUDE - T.G.T. LIMIT 691 DEGREES C. PRE-MOD.1426 - 631 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
KNOTS	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14
200	1370	1355	1335	1315	1300	1280	1265	1245	1230	1210	1195	1180	1160	1145	1120	1115	1100	1085	1070	1055	1040	
210	1390	1375	1355	1335	1320	1300	1280	1255	1245	1230	1210	1195	1180	1160	1145	1130	1115	1095	1080	1065	1050	
220	1400	1390	1370	1350	1330	1315	1295	1280	1260	1240	1225	1205	1190	1175	1155	1140	1125	1110	1090	1075	1060	
230	1410	1410	1390	1370	1350	1330	1310	1290	1275	1255	1240	1220	1200	1185	1170	1150	1135	1120	1105	1090	1075	
240	1420	1420	1405	1385	1365	1345	1325	1310	1290	1270	1250	1235	1215	1200	1180	1165	1150	1130	1115	1100	1085	
250	1430	1430	1420	1400	1380	1360	1345	1325	1305	1290	1270	1250	1235	1215	1200	1180	1165	1150	1130	1115	1100	
260	1445	1445	1440	1420	1400	1380	1360	1340	1320	1305	1285	1265	1250	1230	1215	1195	1180	1160	1145	1130	1115	1100
270	1460	1460	1460	1440	1420	1400	1380	1360	1340	1320	1305	1285	1265	1250	1230	1215	1195	1180	1160	1145	1130	1110
280	1470	1470	1470	1460	1440	1420	1400	1380	1360	1340	1320	1300	1285	1265	1245	1230	1210	1195	1175	1160	1145	1125
	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

22,000 FEET ALTITUDE - T.G.T. LIMIT 693 DEGREES C. PRE-MOD.1426 - 633 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
KNOTS	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12
200	1340	1320	1305	1385	1270	1250	1235	1215	1200	1185	1165	1150	1135	1120	1105	1090	1075	1055	1040	1025	1015	
210	1355	1340	1320	1305	1285	1270	1250	1235	1215	1200	1180	1165	1150	1135	1120	1100	1085	1070	1055	1040	1025	
220	1365	1355	1335	1320	1300	1280	1265	1245	1230	1210	1195	1180	1165	1145	1130	1115	1100	1080	1070	1055	1040	
230	1380	1375	1355	1335	1315	1300	1280	1260	1245	1225	1210	1195	1175	1160	1145	1125	1110	1095	1080	1065	1050	
240	1390	1390	1370	1350	1335	1315	1295	1280	1260	1245	1225	1210	1190	1175	1160	1140	1125	1110	1090	1075	1060	
250	1400	1400	1390	1370	1350	1330	1315	1295	1275	1260	1240	1225	1205	1190	1175	1155	1140	1125	1110	1090	1075	
260	1415	1415	1410	1390	1370	1350	1330	1310	1295	1275	1260	1240	1220	1205	1185	1170	1155	1135	1120	1105	1090	1075
270	1430	1430	1430	1410	1390	1370	1350	1330	1310	1295	1275	1260	1240	1220	1205	1185	1170	1155	1135	1120	1105	1090
280	1440	1440	1440	1430	1410	1390	1370	1350	1330	1315	1295	1275	1255	1240	1220	1205	1185	1170	1150	1135	1120	1105
	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

23,000 FEET ALTITUDE - T.G.T. LIMIT 694 DEGREES C. PRE-MOD.1426 - 634 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																						
KNOTS	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10
200	1310	1305	1290	1270	1255	1235	1220	1205	1190	1170	1155	1140	1125	1110	1095	1080	1065	1050	1030	1015	1005		
210	1325	1325	1310	1290	1270	1255	1240	1220	1205	1185	1170	1155	1140	1120	1105	1090	1075	1060	1045	1030	1015		
220	1335	1335	1320	1305	1290	1270	1250	1235	1220	1200	1185	1170	1155	1135	1120	1105	1090	1075	1060	1045	1030	1015	
230	1345	1345	1340	1320	1305	1285	1270	1250	1235	1220	1200	1185	1170	1150	1135	1120	1100	1085	1070	1055	1040	1025	
240	1360	1360	1360	1340	1320	1305	1285	1270	1250	1235	1215	1200	1185	1165	1150	1135	1120	1100	1005	1070	1055	1040	
250	1370	1370	1370	1360	1340	1325	1305	1285	1270	1250	1235	1215	1200	1180	1165	1150	1130	1115	1100	1085	1170	1055	1040
260	1385	1385	1385	1380	1360	1340	1320	1305	1285	1270	1250	1230	1215	1200	1180	1165	1150	1130	1115	1100	1085	1070	1055
270	1400	1400	1400	1400	1380	1360	1340	1325	1305	1285	1270	1250	1230	1215	1200	1180	1165	1150	1130	1115	1100	1085	1070
280	1410	1410	1410	1410	1400	1380	1360	1340	1325	1305	1385	1270	1250	1235	1215	1200	1180	1165	1150	1130	1115	1100	1080
	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2		
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																						

TYNE Mk.515 - FUEL FLOW CONTROL TABLE - CRUISE AT 88.3% (13500) L.P. R.P.M. AND 1164°K.

24,000 FEET ALTITUDE - T.G.T. LIMIT 696 DEGREES C. PRE-MOD.1426 - 636 DEGREES C. MOD 1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
KNOTS	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8
190	1270	1260	1240	1225	1210	1190	1175	1160	1145	1130	1115	1100	1085	1070	1055	1040	1025	1010	995	980	970		
200	1285	1275	1260	1240	1225	1210	1190	1175	1160	1145	1130	1115	1100	1080	1065	1050	1035	1020	1005	995	980		
210	1290	1290	1275	1255	1240	1225	1205	1190	1175	1160	1140	1125	1110	1095	1080	1065	1050	1035	1020	1005	990		
220	1305	1305	1290	1275	1255	1240	1225	1210	1190	1175	1160	1145	1125	1110	1095	1080	1065	1050	1035	1020	1005	990	
230	1315	1315	1305	1290	1270	1255	1235	1220	1205	1185	1170	1155	1140	1125	1105	1090	1075	1060	1045	1030	1015	1000	
240	1330	1330	1325	1310	1290	1275	1255	1240	1220	1205	1190	1170	1125	1140	1125	1110	1090	1075	1060	1045	1030	1015	
250	1340	1340	1340	1330	1310	1295	1275	1260	1240	1225	1205	1190	1170	1155	1140	1125	1105	1090	1075	1060	1045	1030	
260	1355	1355	1355	1350	1330	1210	1295	1275	1260	1240	1225	1205	1190	1175	1155	1140	1125	1110	1095	1080	1060	1045	1030
270	1370	1370	1370	1370	1350	1330	1310	1295	1275	1260	1240	1225	1205	1190	1175	1155	1140	1125	1110	1090	1075	1060	1045
	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4		
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

25,000 FEET ALTITUDE - T.G.T. LIMIT 697 DEGREES C. PRE-MOD.1426 - 637 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
KNOTS	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	+2	+4	+6
180	1225	1215	1195	1180	1165	1150	1135	1120	1105	1090	1075	1060	1045	1030	1015	1000	990	975	960	960	935		
190	1235	1225	1210	1190	1175	1160	1145	1130	1115	1100	1085	1070	1055	1040	1025	1010	1000	985	970	955	940		
200	1250	1240	1225	1210	1195	1180	1165	1150	1130	1115	1100	1090	1075	1060	1045	1030	1015	1000	985	970	960		
210	1260	1260	1245	1225	1210	1195	1180	1160	1145	1130	1115	1100	1085	1070	1055	1040	1030	1015	1000	985	970	960	
220	1275	1275	1260	1245	1230	1220	1195	1180	1165	1150	1135	1120	1100	1085	1070	1055	1040	1025	1010	995	980	970	
230	1285	1285	1275	1260	1245	1225	1210	1195	1180	1160	1145	1130	1115	1100	1085	1070	1055	1040	1025	1010	995	980	
240	1300	1300	1295	1280	1260	1245	1230	1210	1195	1180	1160	1145	1130	1115	1100	1085	1070	1055	1040	1025	1010	995	
250	1315	1315	1315	1300	1285	1265	1250	1230	1215	1200	1180	1165	1150	1130	1115	1100	1085	1070	1055	1040	1025	1010	995
260	1325	1325	1325	1320	1300	1285	1265	1250	1230	1215	1200	1180	1165	1150	1135	1115	1100	1085	1070	1055	1040	1025	1010
	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6		
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

26,000 FEET ALTITUDE - T.G.T. LIMIT 699 DEGREES C. PRE-MOD.1426 - 639 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																					
KNOTS	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	+2	+4
180	1195	1175	1160	1145	1130	1120	1105	1090	1075	1060	1050	1035	1020	1005	995	980	965	950	940	925	910		
190	1205	1195	1180	1165	1150	1135	1120	1105	1090	1075	1060	1045	1030	1020	1005	990	975	960	950	935	920		
200	1220	1210	1195	1180	1165	1150	1135	1120	1105	1090	1075	1060	1045	1030	1020	1005	990	975	960	945	935		
210	1230	1225	1210	1195	1180	1165	1150	1135	1120	1105	1090	1075	1060	1045	1030	1015	1000	990	975	960	945	935	
220	1245	1245	1230	1215	1195	1180	1165	1150	1135	1120	1105	1090	1075	1060	1045	1030	1015	1000	990	975	960	945	
230	1255	1255	1245	1230	1215	1200	1180	1165	1150	1135	1120	1105	1090	1075	1060	1045	1030	1015	1000	985	970	960	
240	1270	1270	1265	1250	1235	1220	1200	1185	1170	1155	1140	1120	1105	1090	1075	1060	1045	1030	1015	1000	985	970	
250	1280	1280	1280	1265	1250	1235	1220	1200	1185	1170	1155	1140	1120	1105	1090	1075	1060	1045	1030	1015	1000	985	970
260	1295	1295	1295	1285	1270	1255	1235	1220	1205	1185	1170	1155	1140	1125	1110	1090	1075	1060	1045	1030	1015	1000	985
	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8		
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																					

27,000 FEET ALTITUDE - T.G.T. LIMIT 700 DEGREES C. PRE-MOD.1426 - 640 DEGREES C. MOD.1426

IAS	INDICATED AIR TEMPERATURE DEGREES C. (WITHOUT HOT AIR ANTI-ICING)																						
KNOTS	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	+2
170	1150	1145	1130	1115	1105	1090	1075	1060	1045	1035	1020	1005	995	980	965	955	940	930	915	905	890	880		
180	1160	1160	1145	1130	1115	1105	1090	1075	1060	1050	1035	1020	1005	995	980	965	955	940	925	915	900	890		
190	1170	1170	1160	1145	1130	1120	1105	1090	1075	1060	1050	1035	1020	1005	995	980	965	955	940	930	915	900	890	
200	1185	1185	1175	1160	1150	1135	1120	1105	1090	1080	1065	1050	1040	1025	1010	995	980	965	955	940	925	910	900	
210	1200	1200	1195	1180	1165	1150	1135	1125	1110	1095	1080	1065	1050	1040	1025	1010	995	980	965	955	940	925	915	
220	1210	1210	1210	1200	1185	1170	1155	1140	1125	1110	1095	1080	1070	1055	1040	1025	1010	995	980	965	955	940	925	
230	1225	1225	1225	1215	1200	1185	1170	1155	1140	1125	1110	1095	1080	1065	1050	1035	1020	1005	995	980	965	950	935	
240	1240	1240	1240	1235	1220	1205	1190	1175	1160	1145	1130	1110	1100	1085	1070	1055	1040	1025	1010	995	980	965	950	940
250	1250	1250	1250	1250	1240	1225	1205	1190	1175	1160	1145	1130	1115	1100	1085	1070	1055	1040	1025	1010	995	980	965	950
	-52	-50	-48	-46	-44	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6
	INDICATED AIR TEMPERATURE DEGREES C. (WITH HOT AIR ANTI-ICING)																						

SECTION 6

DESCRIPTION

1. General

The Canadair CL-44D4 is a four-engined low-wing long range aircraft. The primary role of the aircraft is the transportation of cargo but certain versions may be equipped to carry passengers or passengers and cargo. For a general arrangement of the cargo aircraft, refer to Figure 1.

2. Crew

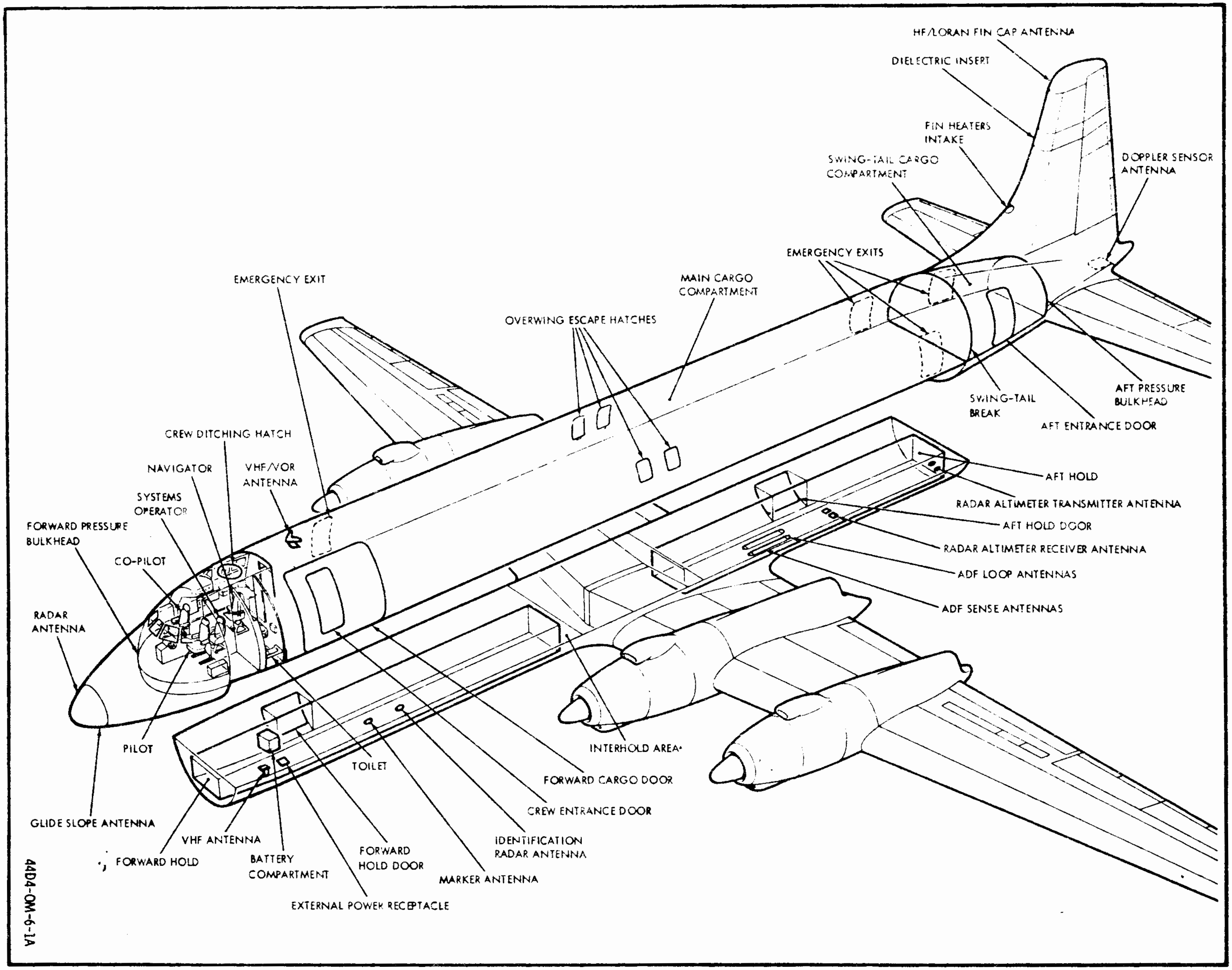
The flight crew consists of three mandatory members, pilot, co-pilot and systems operator, and an optional navigator/radio operator.

3. Airframe

The all-metal fuselage is of semi-monocoque construction and is completely sealed for pressurization from the hemi-spherical section enclosing the cockpit to the aft pressure bulkhead at the tail except for an underfloor area between the forward and aft holds. The main cargo compartment is a Class E compartment, conforming to Civil Air Regulations, (CAR) Part 4b, the main conditions of which specify that the compartment is fire-resistant, that a smoke detector system is installed and that the ventilating airflow can be shut off. The underfloor holds are not accessible during flight and are classified as Class D compartments, CAR Part 4b. The main conditions of this classification state that the compartments must be lined with fire-resistant material, that the ventilation can be controlled in the event of fire and that the fire can be contained within that compartment.

Replaceable ice-protection plates are fitted to each side of the fuselage opposite the inboard propellers. The tail section of the aircraft is hinged on the starboard side of the fuselage and is swung open through 105° for cargo loading and unloading.

The full cantilever wing is of box-spar and stressed-skin construction and incorporates the fuel tanks. The box spar carries the attachments for the ailerons and the main landing gear units and passes through the unpressurized portion of the centre section of the fuselage below the main compartment floor. The ailerons are metal covered.



General Arrangement Diagram
Figure 1

The vertical and horizontal stabilizers, which are detachable, have box spars and are generally similar in construction to the main plane. The rudder and elevators are metal covered. The upper part of the vertical stabilizer is isolated by a dielectric insert to form the fin cap antenna. The rudder is constructed in two sections, the upper section of which has a dielectric insert to correspond with the insert of the vertical stabilizer.

4. Engines

The aircraft is powered by four Rolls-Royce Tyne 12, Mark 515 axial-flow twin shaft propeller-turbine engines. For best power performance under specific conditions, refer to Sections 4 and 5.

Each engine incorporates a six-stage low pressure (LP) compressor coupled to and driven by a three-stage turbine and a nine-stage high pressure (HP) compressor coupled to and driven by a single turbine. The propeller is driven through a compound epicyclic reduction gear from the LP shaft which passes through the concentric but independent HP shaft.

5. Propellers

Dehavilland Hydromatic propellers are installed, incorporating manual feathering, automatic drag limiting system (ADLS), reversing, mechanical and hydraulic pitch locks and a flight idle stop and a Beta control stop. The propeller blades and spinners are equipped with electrothermal de-icer mats.

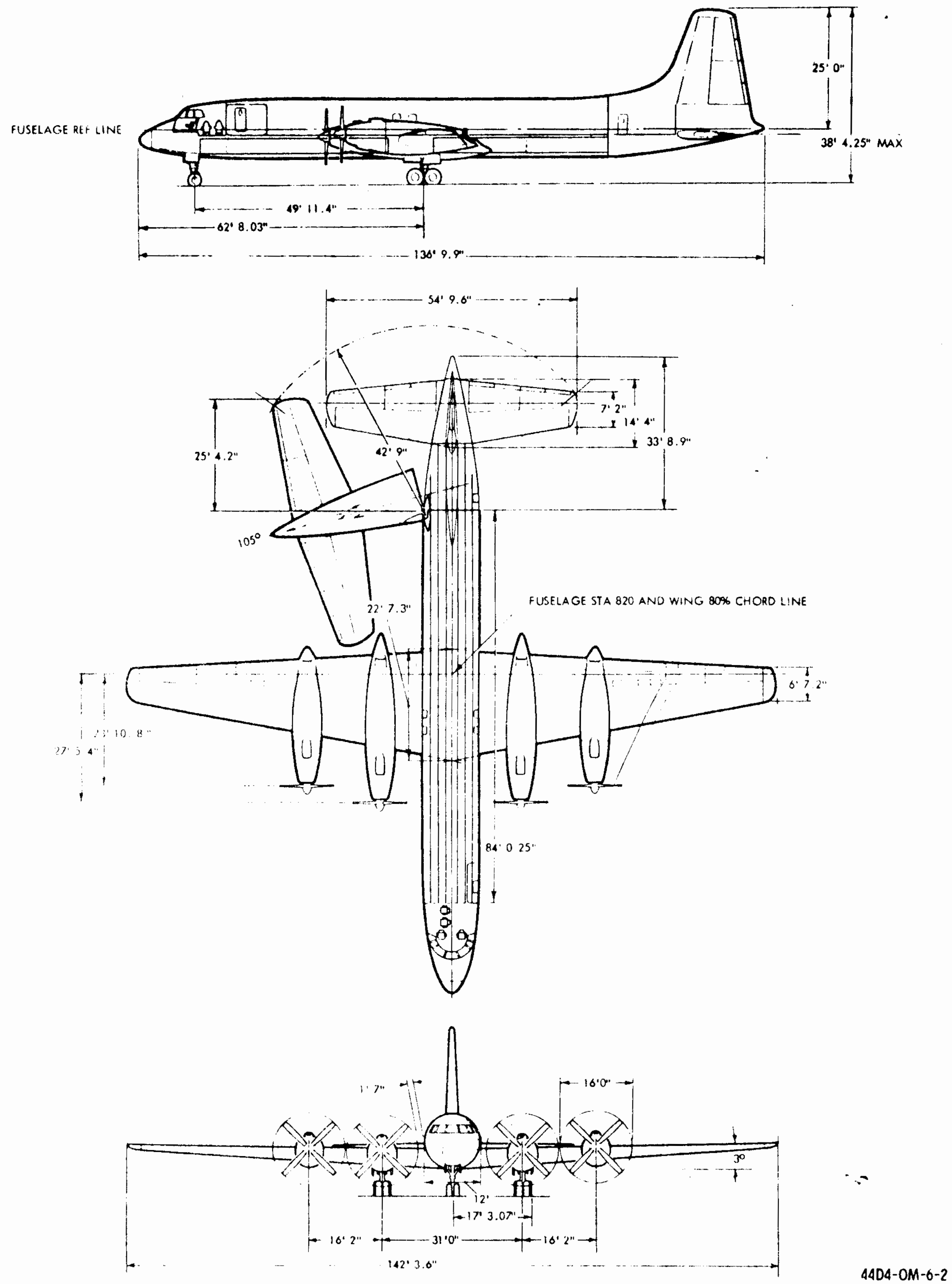
6. Dimensions (Ref. Fig. 2)

(1) Overall Dimensions

Span	142 ft 3-5/8 in
Length	139 ft 9-7/8 in
Height to tip of vertical stabilizer	
Tail open	38 ft 2-7/8 in (max) 35 ft 10-3/8 in (max)
Tail closed	38 ft 4-1/4 in (max) 35 ft 11 3/4 in (min)

(2) Wing

Root chord (Theoretical at fuselage center-line)	22 ft 7.27 in



Aircraft Dimensions
Figure 2

Dihedral	3°

(3) Horizontal Stabilizers and Elevators

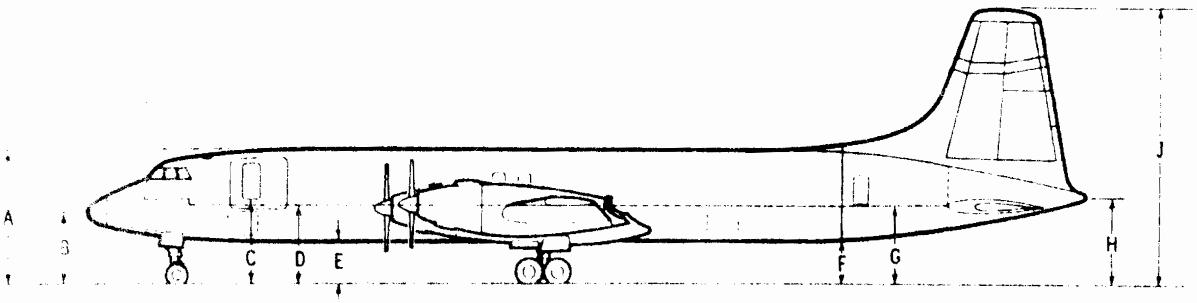
Span	54 ft 9-5/8 in
Root chord (Theoretical at fuselage centre-line)	14 ft 4 in
Dihedral	0°

(4) Fuselage

Maximum diameter	12 ft 0 in
Height of cargo floor (aircraft unloaded)	
At fuselage break - tail open	11 ft 10-1/4 in (max) 11 ft (min)
At forward cargo door - tail open	10 ft 6-1/4 in (max) 10 ft 3-5/8 in (min)
At forward cargo door - tail closed	10 ft 8-3/4 in (max) 10 ft 6 in (min)

(5) Size of doors

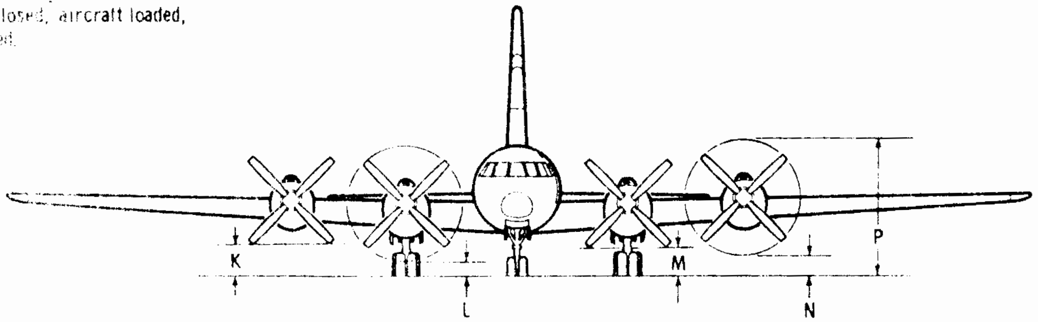
Forward cargo	73 in x 93 in
Crew entrance	60 in x 28-1/2 in
Forward hold	52-1/4 in x 30 in
Aft hold	51-1/4 in x 31 in
Rear entrance	68 in x 30 in
Emergency	54 in x 24 in



	MAXIMUM		MINIMUM	
	FEET	INCHES	FEET	INCHES
A	17	10-1/8	17	1-1/4
B	9	4-7/8	8	8-5/16
C	11	2-9/16	10	7-1/4
D	10	8-3/4	10	3-5/8
E	5	10-1/8	5	2-1/4
F	7	3-1/8	5	1-1/4
G	11	10-1/4	11	0
H	13	10-3/4	11	2-1/8
J	38	4-1/4	35	10-3/8

NOTE

The maximum and minimum dimensions shown reflect one or more, or combination of the following configurations:
Tail open, tail closed, aircraft loaded, aircraft unloaded.



	MAXIMUM		MINIMUM	
	FEET	INCHES	FEET	INCHES
K	5	5-7/8	4	0-5/8
L	2	3-1/4	1	2-7/8
M	4	7-1/2	3	7-1/8
N	3	1-5/8	1	8-3/8
P	19	1-5/8	17	8-3/8

44D4-OM-6-3A

Ground Clearances
Figure 3

(6) Areas

Wing (total including ailerons, flaps retracted)	2075 sq ft
Ailerons (total including tab areas)	140.4 sq ft
Aileron tabs (total)	23.32 sq ft
Effective flap (total)	388 sq ft
Horizontal stabilizers (total including elevators)	586 sq ft
Elevators (total including tab areas)	170 sq ft
Elevator tabs (total)	20.6 sq ft
Vertical stabilizer (including dorsal fin, rudder and tabs)	361.2 sq ft
Rudder (including tabs)	92.2 sq ft
Rudder tabs	8.7 sq ft

(7) Usable floor area

Main cargo compartment (from flight compartment rear bulkhead to the fuselage break)	924 sq ft
Swing tail compartment	128 sq ft (Cargo aircraft)
Forward hold	162 sq ft
Aft hold	173 sq ft

(8) Ground Clearances (Ref. Fig. 3)

Under fuselage (at fuselage break line)

Aircraft unloaded

Tail closed	7 ft 0-3/4 in (max) 6 ft 5-5/8 in (min)

Tank or Reservoir	Fluid Capacity		Unusable		Trapped		Air Space		Total Volume	
	US Gal	Imp Gal	US Gal	Imp Gal	US Gal	Imp Gal	US Gal	Imp Gal	US Gal	Imp Gal
No. 1 Fuel Tank	2258	1880	30	25	0.6	0.5	80	67	2369	1973
No. 2 Fuel Tank	2243	1868	40	33	0.6	0.5	91	76	2375	1978
No. 3 Fuel Tank	2243	1868	40	33	0.6	0.5	89	74	2373	1976
No. 4 Fuel Tank	2258	1880	30	25	0.6	0.5	75	63	2364	1969
No. 5 Fuel Tank	522	435	3	2	0.3	0.25	34	29	559	466
No. 6 Fuel Tank	1954	1626	11	10	7.8	6.5	77	64	2050	1707
No. 7 Fuel Tank	522	435	3	2	0.3	0.25	34	29	559	466
Hydraulic Reservoir	7.25	6.04					3.25	2.71	10.5	8.75
Feel System Reservoir	1.1	0.9							1.1	0.9
CSD Oil Tank	2.368	1.95	0.132	0.11			0.734	0.61	3.234	2.67
Engine Oil Tank (each tank)	62.4* pints	52* pints								

*Including feathering reserve of 19.2 US (16 Imp) pints and useable oil quantity of 24.0 US (20 Imp) pints.

NOTE: The quantities listed in the Unusable and Trapped columns may vary slightly with each aircraft.

Fluid Quantities
Figure 4

Tail open	7 ft 3-1/8 in (max) 6 ft 5 in (min)
Aircraft loaded	
Tail closed	5 ft 9-1/8 in (max) 5 ft 1-1/4 in (min)
Tail open	5 ft 11-7/8 in (max) 5 ft 1-3/4 in (min)

7. Weights

For details of maximum weights, refer to Section 3.

8. Capacities

(1) Compartment Capacities

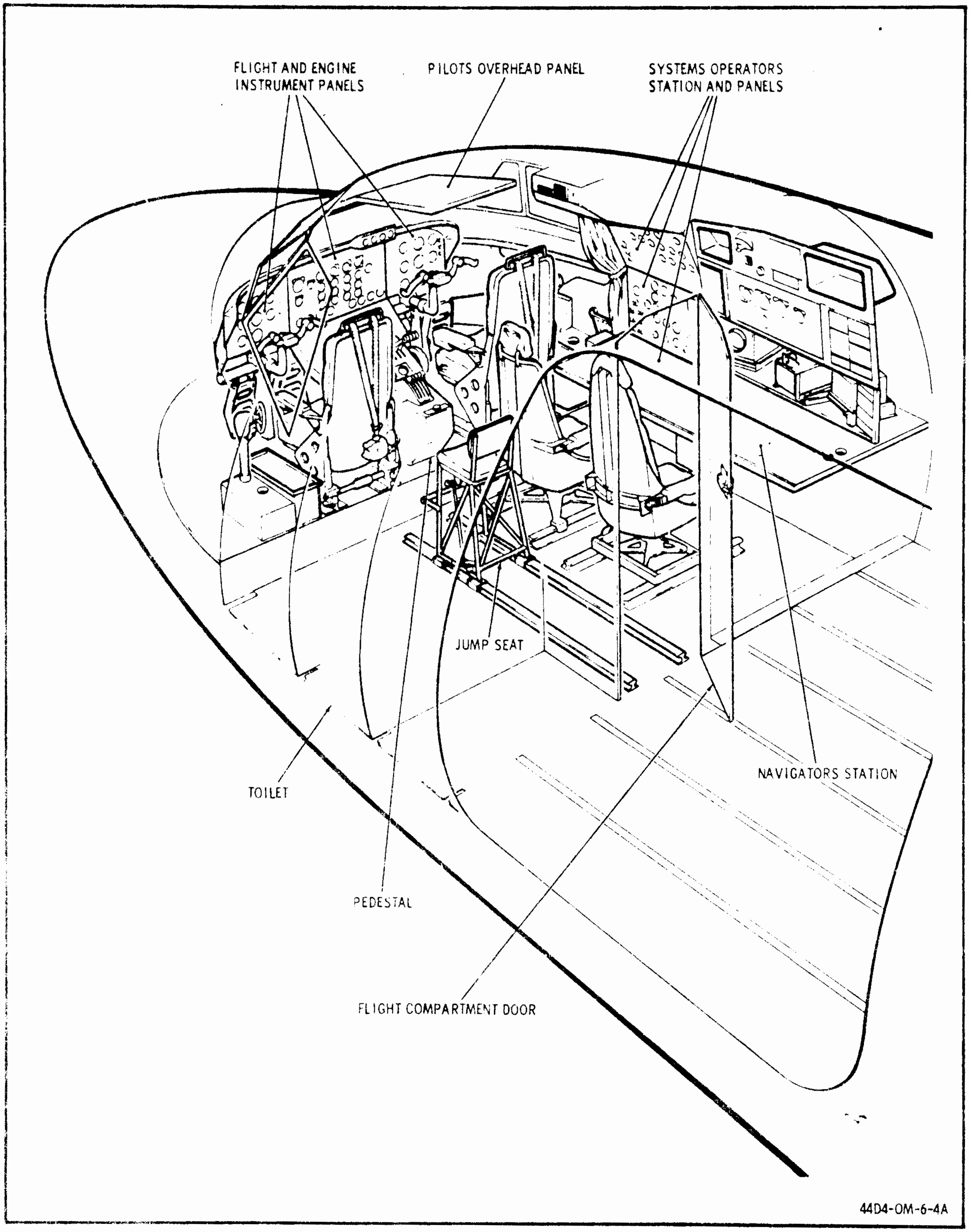
Main cargo compartment (from flight compartment rear bulkhead to the fuselage break)	5,574 cu ft
Swing tail compartment	720 cu ft
Swing Tail Compartment (Convertible Interior)	320 cu ft
Forward hold	523 cu ft
Aft hold	586 cu ft

(2) Fluid Capacities

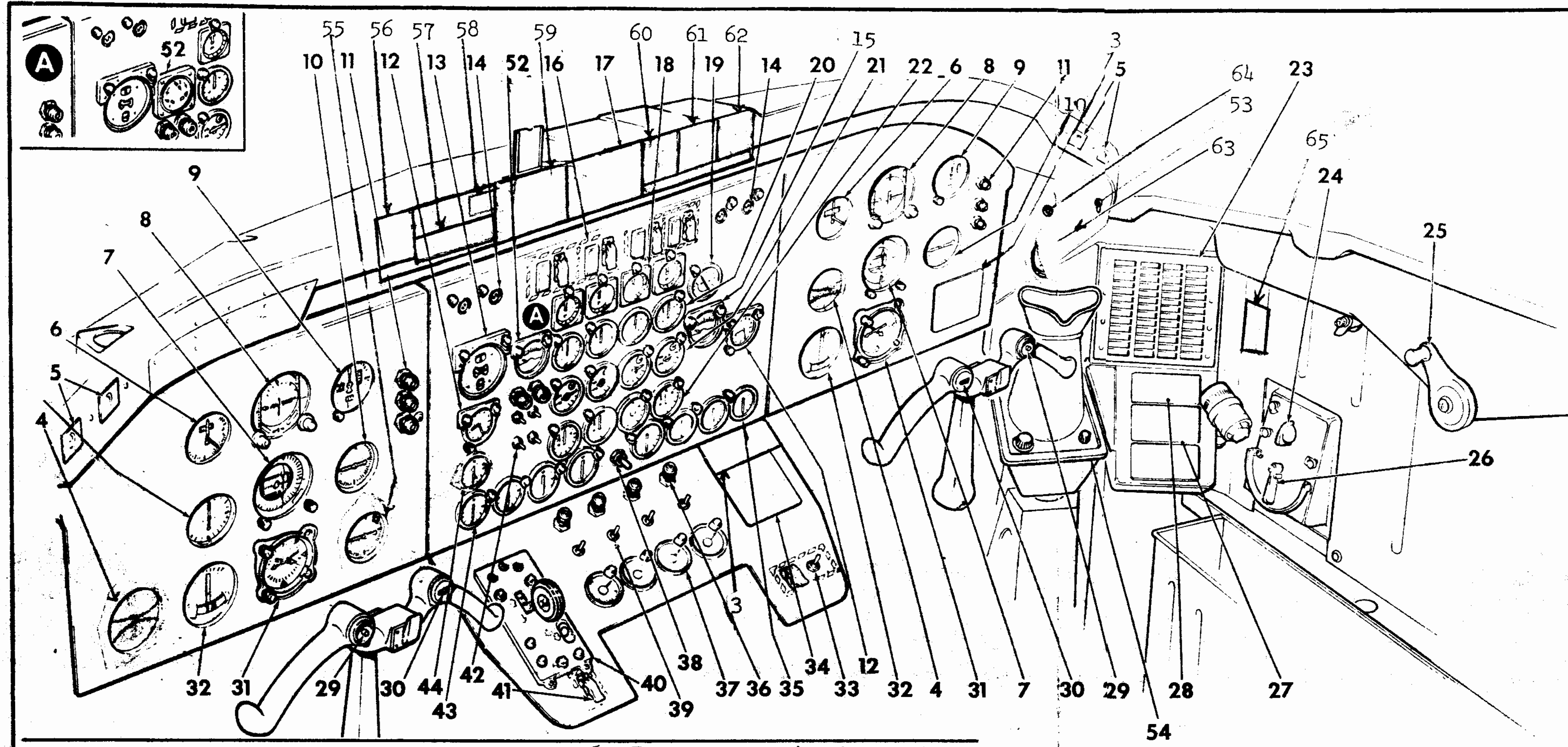
For details on fluid capacities, refer to Figure 4.

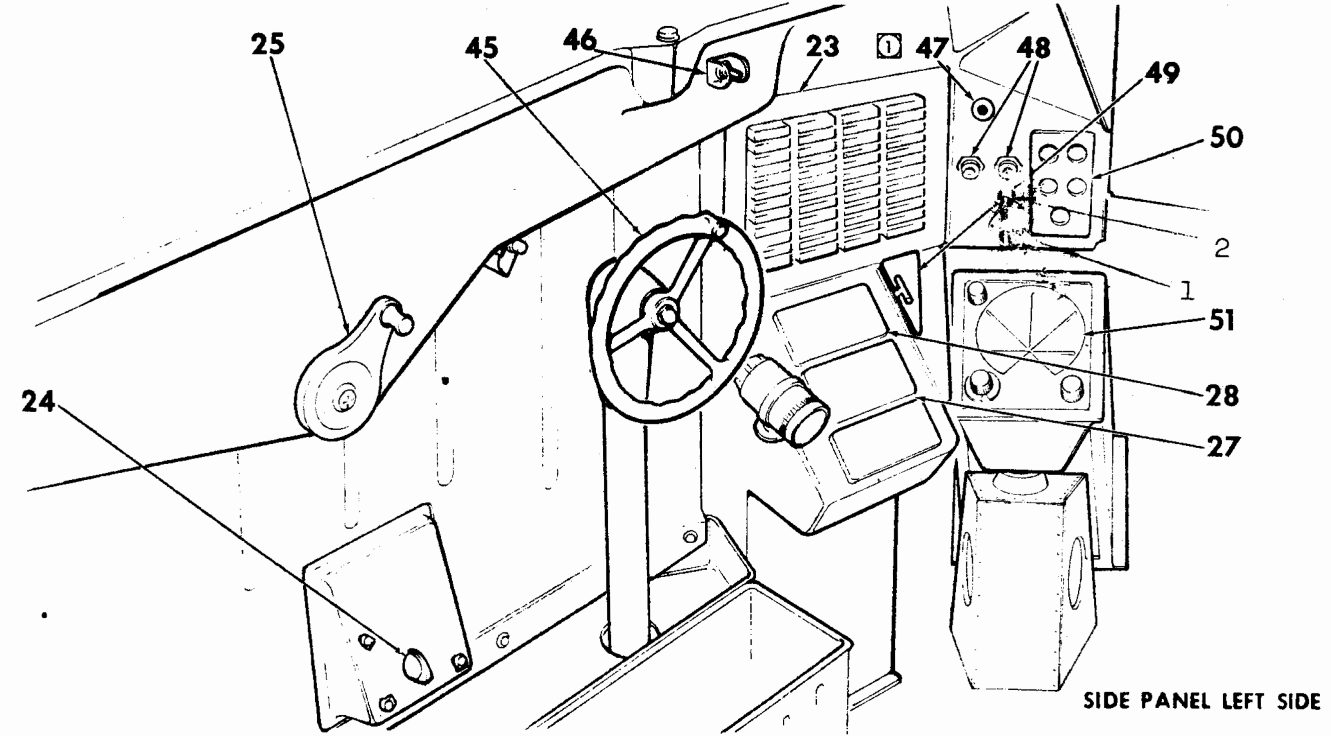
9. Flight Compartment

The flight compartment is arranged as shown in Figure 5. The pilot and co-pilot are provided with duplicate flight instruments and various other instruments to suit their particular requirements. Engine instruments are grouped on a centre panel and are readily visible to each pilot. In addition, each pilot has a side console which contains various instruments and controls (Ref. Fig. 6). An overhead switch panel, accessible to each pilot is provided (Ref. Fig. 7). Instruments and controls that are grouped on the pedestal are detailed in Figure 8.



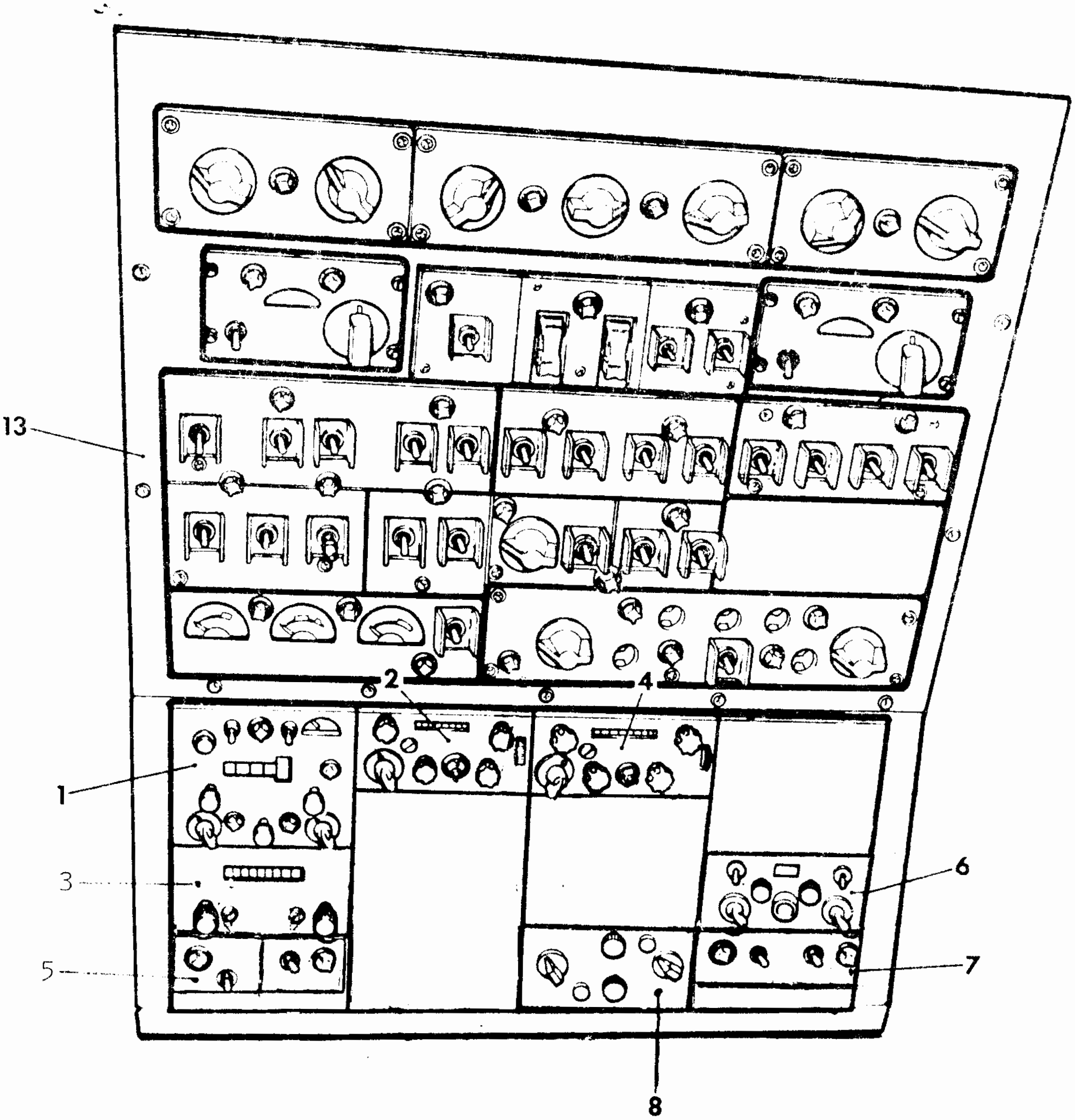
Flight Compartment
Figure 5





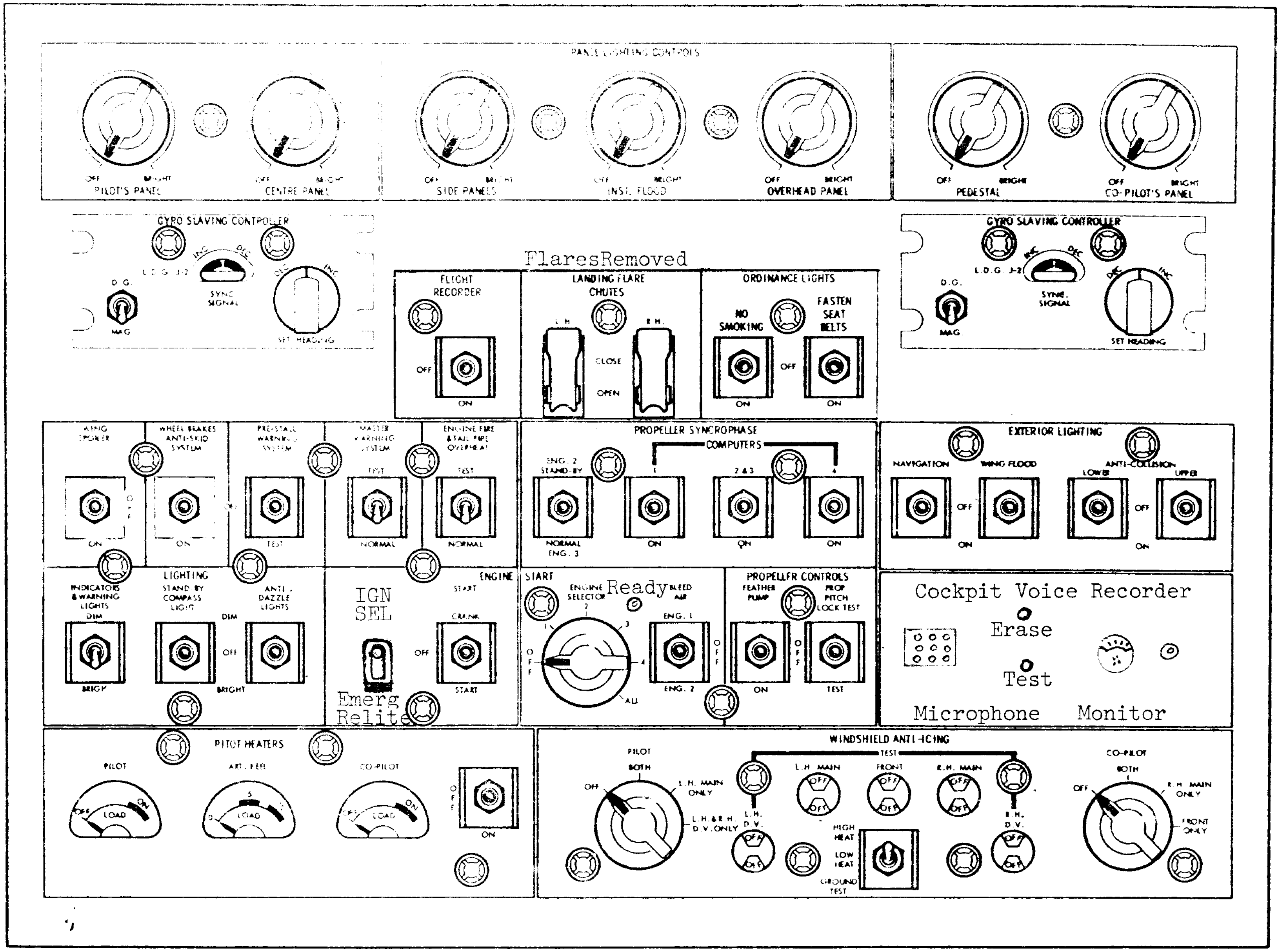
1 VERTICAL GYRO SELECTOR SWITCH
2 COMPASS SYSTEM SELECTOR SWITCH
3 AIR SPEED LIMITATIONS CARD
4 D.M.E.
5 MASTER WARNING SYSTEM LIGHTS
6 AIRSPEED INDICATOR
7 HEADING AND COURSE INDICATOR
8 APPROACH HORIZON
9 ALTIMETER
10 VERTICAL SPEED INDICATOR
11 MARKER BEACON INDICATOR LIGHTS
12 CLOCK
13 AUTO PILOT INDICATOR
14 IDLING THROTTLE VALVE POSITION INDICATORS
15 OUTSIDE AIR TEMPERATURE INDICATOR
16 ENGINE FIRE CONTROL PANEL
17 Omega 2.
18 TORQUE PRESSURE INDICATORS
19 FLAP POSITION INDICATOR
20 LP TACHOMETERS
21 TURBINE GAS TEMPERATURE INDICATORS
22 HP TACHOMETERS
23 ANNUNCIATOR PANEL MASTER WARNING SYSTEM
24 WINDSHIELD WIPER CONTROL SWITCH
25 DV WINDOW OPERATING HANDLE
26 PITOT STATIC SELECTOR
27 INTERCOM CONTROLS
28 OXYGEN REGULATOR
29 AUTO PILOT EMERGENCY DISENGAGE BUTTON
30 TRANSMIT/INTERPHONE SWITCH
31 RADIO MAGNETIC INDICATOR
32 TURN AND BANK INDICATOR
33 WING FLAP NORMAL - ALTERNATE CONTROL SWITCH GROUP
34 ENGINE LIMITATIONS CARD
35 OIL PRESSURE INDICATORS
36 BETA RANGE WARNING LIGHTS
37 OIL TEMPERATURE INDICATORS
38 FUEL FLOW NORMAL - STAND-BY SWITCH
39 OIL COOLER FLAP CONTROL SWITCHES
40 LANDING GEAR CONTROL PANEL
41 LANDING GEAR EMERGENCY EXTENSION SWITCH
42 LANDING AND TAXI LIGHT SWITCHES AND INDICATOR LIGHTS
43 FUEL FLOW INDICATORS
44 Pressure Altitude
45 NOSE WHEEL STEERING CONTROL
46 NOSE WHEEL STEERING DISCONNECT SWITCH
47 ATTENDANTS CALL BUTTON (Not used)
48 SPOILER MOVEMENT INDICATOR LIGHTS
49 AIR CONDITIONING VALVE
50 CONTROL SURFACES POSITION INDICATORS
51 WEATHER RADAR INDICATOR AND CONTROLS
52 SYNCHROSCOPE
53 Gust Lock Bypass
54 WEATHER RADAR INDICATOR AND CONTROLS
55 Standby Horizon
56 V.H.F. NAV. 1.
57 A.D.F. Control
58 Altitude Reminder
59 Omega 1.
60 V.H.F. NAV. 2.
61 V.H.F. COMM. 1.
62 V.H.F. COMM. 2.
53 Gust lock bypass
63 Z.F.W. Set
64 Z.F.W. Test(Aural Warning)
65 C.B. Panel

Cockpit Instrument Panels and Side Consoles
Figure 6



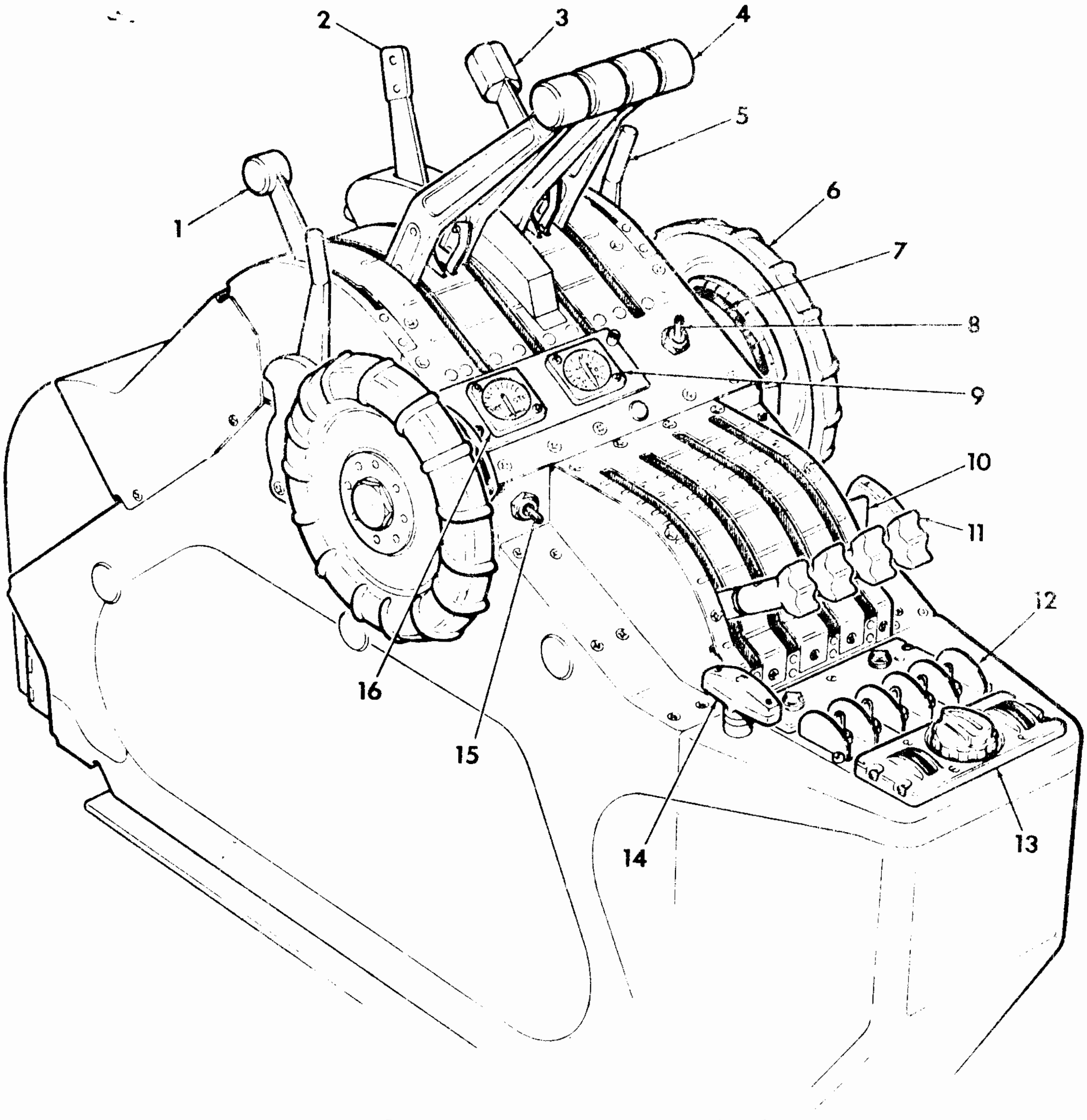
1 ADF1 Control Panel
2 HF1 Control Panel
3 VHF Control Panel
4 HF2 Control Panel
5 VOR & DME Selector Panel
6 ATC Transponder Control Panel
7 Marker Beacon Control Panel
8 Weather ~~Panel~~ Control Panel

Pilots Overhead Panel - General
Figure 7 (1 of 2)



44D4-OM-6-19C

Pilots Overhead Panel - Switch Panel
Figure 7 (2 of 2)



1	AUTO PILOT DISCONNECT LEVER	9	AILERON TRIM INDICATOR
2	AIR/GROUND LEVER	10	WING FLAP CONTROL
3	GUST LOCK LEVER	11	CONDITION LEVERS
4	POWER LEVERS	12	AUTO PILOT FUNCTION SELECTOR
5	FRICTION LOCK LEVER	13	AUTO PILOT MANOEUVRING CONTROLLER
6	ELEVATOR TRIM WHEEL	14	FEEL SIMULATOR DISENGAGE LEVER
7	ELEVATOR TRIM INDICATOR	15	RUDDER TRIM SWITCH
8	AILERON TRIM SWITCH	16	RUDDER TRIM INDICATOR

44D4-OM-6-8A

Pilots Pedestal
Figure 8

The windshield consists of seven panels of electrically heated flat laminated glass capable of withstanding bird impact in accordance with Civil Air Regulations, (CAR) Part 4b. Two panels (DV) can be opened inwards when the aircraft is unpressurized, giving direct vision to the pilots. Windshield wipers are provided for the panel immediately in front of each pilot.

The systems operators station is illustrated in Figure 9, the instrument layout being divided basically into three main panels, overhead, centre and lower.

Radio, radar and electronic equipment is provided at the navigators station (Ref. Fig. 9). A mounting assembly for the periscopic sextant is located on the flight compartment roof behind the navigators position. Provision is made for the installation of a foldable platform below the sextant mounting. The platform is adjustable for height.

10. General Servicing Data

The aircraft can be serviced in a minimum of time with little interference between the ground crew servicing the aircraft systems and those engaged in unloading and loading operations. Care should be exercised by personnel when using the designated walkways. Soft shoes must be worn and wing mats used to protect the exterior surfaces. For a diagram of a typical servicing layout and the location of walkways, refer to Figure 10. The location and identification of the various access panels and replenishing points neccessary for a normal turnaround check are shown in Figure 11.

11. Tire Pressures

The recommended tire pressures for normal operation are as follows:

(1) For aircraft weights of 160, 000 pounds and over:

Nose wheel	130 (±5) psi
Main wheels	165 (±5) psi

(2) For aircraft weights under 160, 000 pounds:

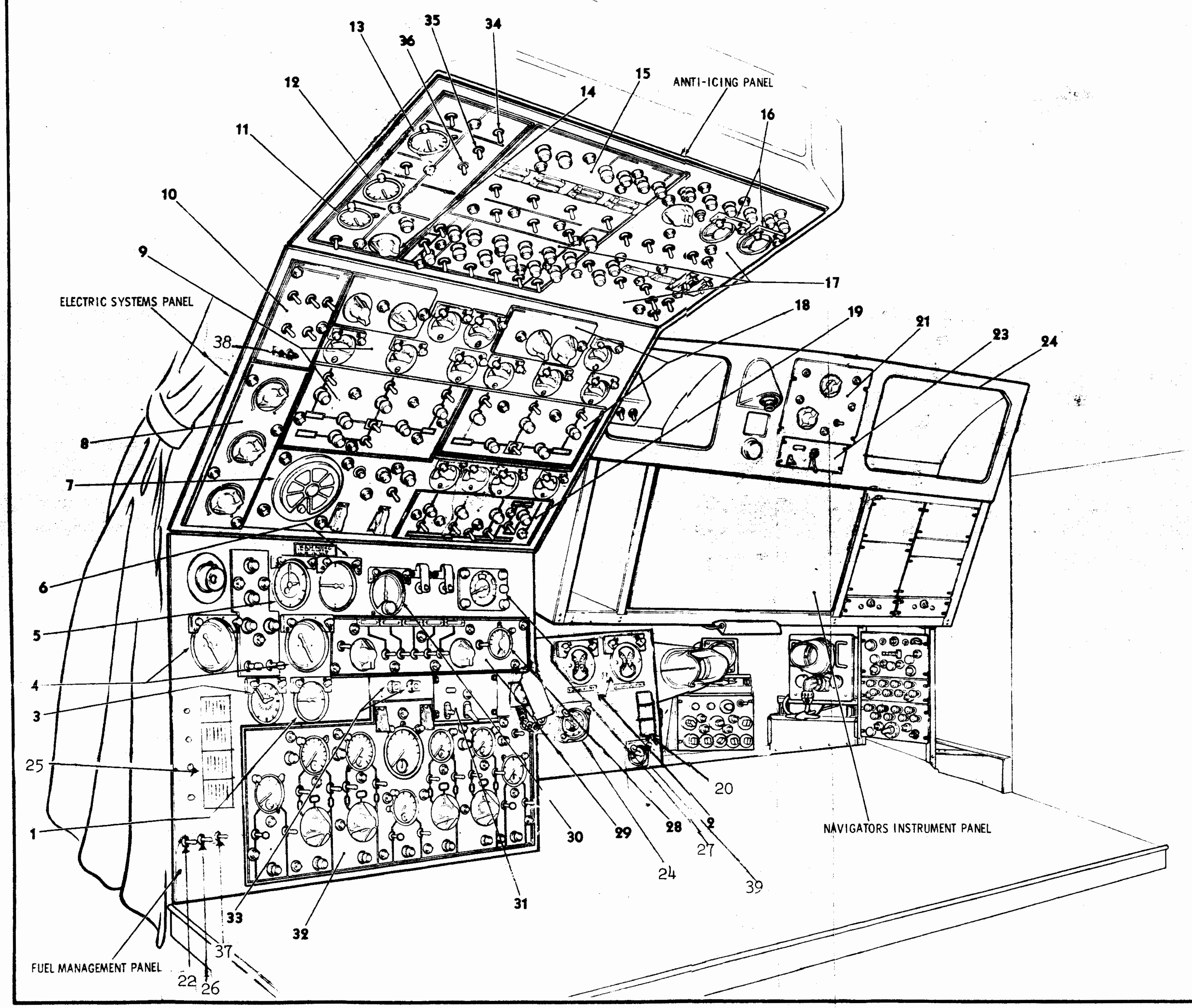
Nose wheel	115 (±5) psi
Main wheels	135 (±5) psi

12. Mooring

If the duration of stay at the parking site is expected to be of some length or if winds of 30 mph or over are expected, the aircraft must be moored. Aircraft tie-down points are shown in Figure 12.

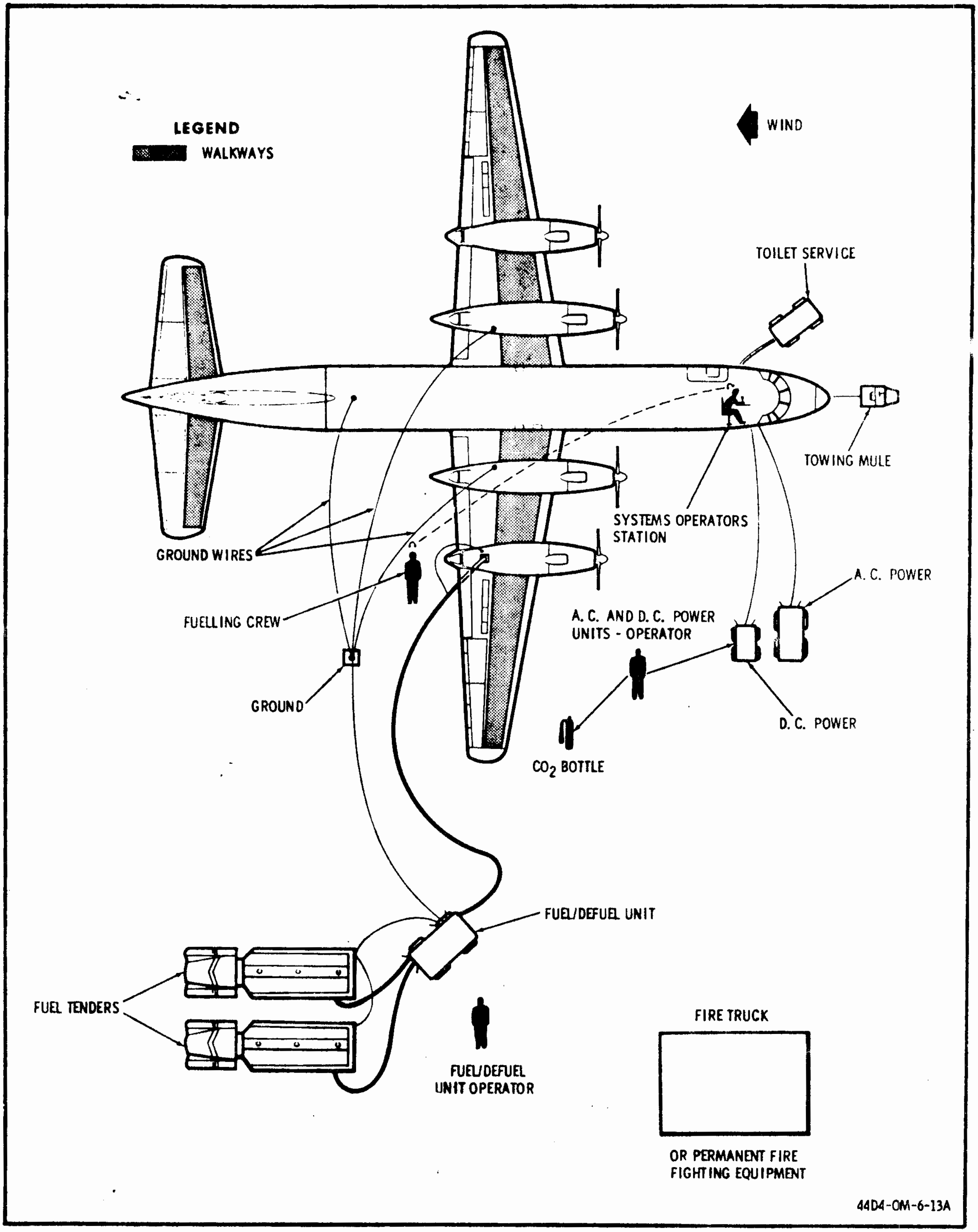
13. Turning Radii

For minimum turning radii of the aircraft under its own power or under tow, refer to Figure 13.

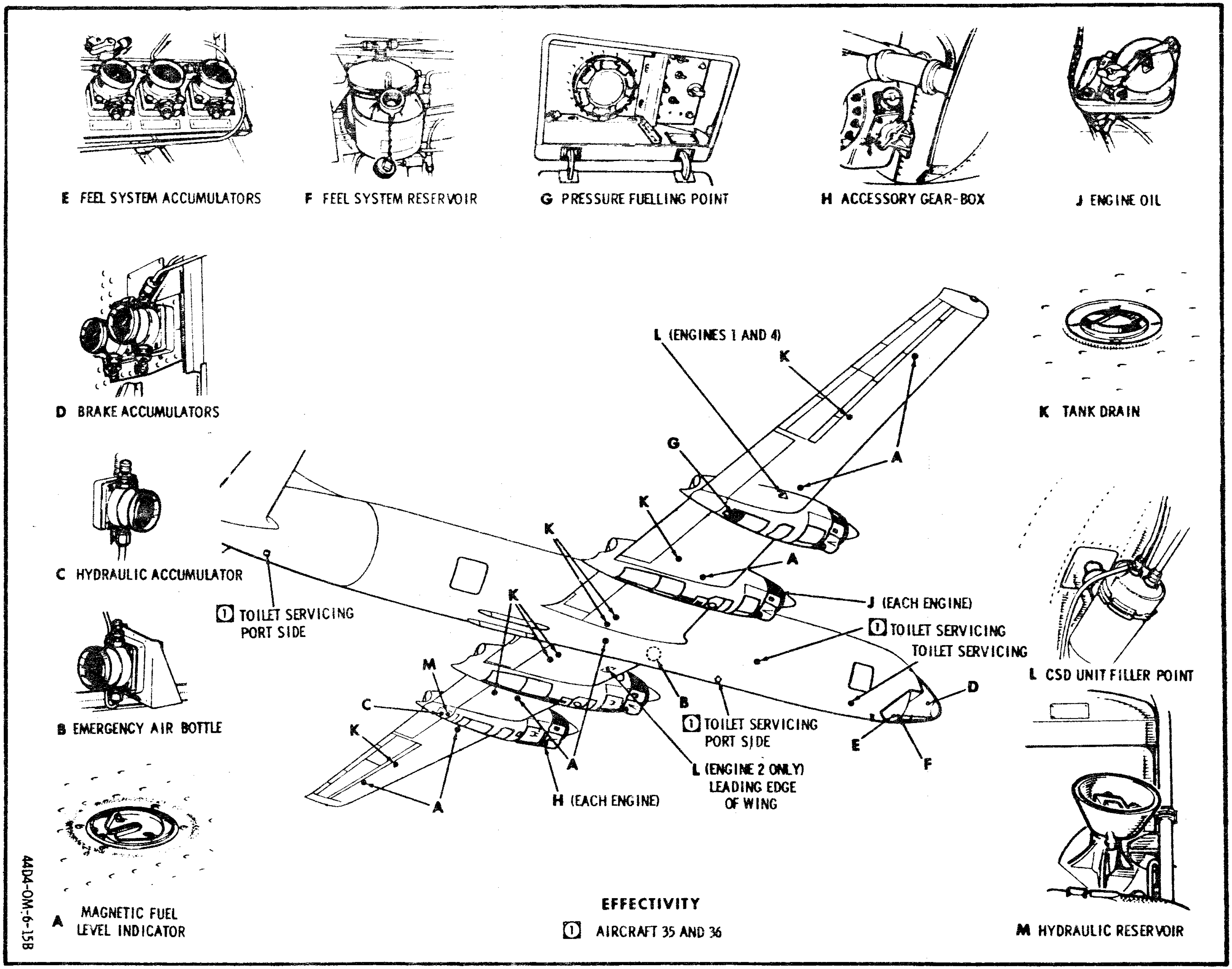


1 Oxygen
2 HP Compressor Rear Bearing Scavenge Oil Temp Indicators
3 Clock
4 Airflow Indicators
5 Cabin Altitude and Differential Pressure Indicator
6 Cabin Rate-of-Climb Indicator
7 Smoke Indicator
8 Systems Operators Panels, Lighting Controls
9 Constant-Frequency A.C. System Controls and Meters
10 Cabin Lighting Controls
11 Main System Hydraulic Pressure Indicator
12 Front Brake Hydraulic Pressure Indicator
13 Rear Brake Hydraulic Pressure Indicator
14 Pneumatic Pressure Control
15 De-icing Controls and Lights
16 Skin Temperature Indicators
17 Anti-icing Controls and Lights
18 Variable-Frequency A.C. System Controls and Meters
19 D.C. System Controls and Meters
20 C.S.D. Warning
21 Navigators Lighting Controls Panel
22 Prop. Suppress.
23 Oxygen Regulator
24 Altimeter
25 Vib. Indicators
26 Test (Vib.)
27 Cabin Pressure Master Controller
28 Cabin Air Temperature Indicator
29 Air Conditioning Controls
30 Cabin Pressure Manual Override Control
31 Oxygen Regulator
32 Fuel Controls and Fuel Quantity Indicators
33 Master Caution and Warning Lights
34 Drain Heater Switch (Not Used)
35 Water Heater Switch (Not Used)
36 Water System (Not Used)
37 Pwr. On (Vib.)
38 Reading Lts. (Not Used)
39 Free Air Temp.

Systems Operators and Navigators Stations
Figure 9



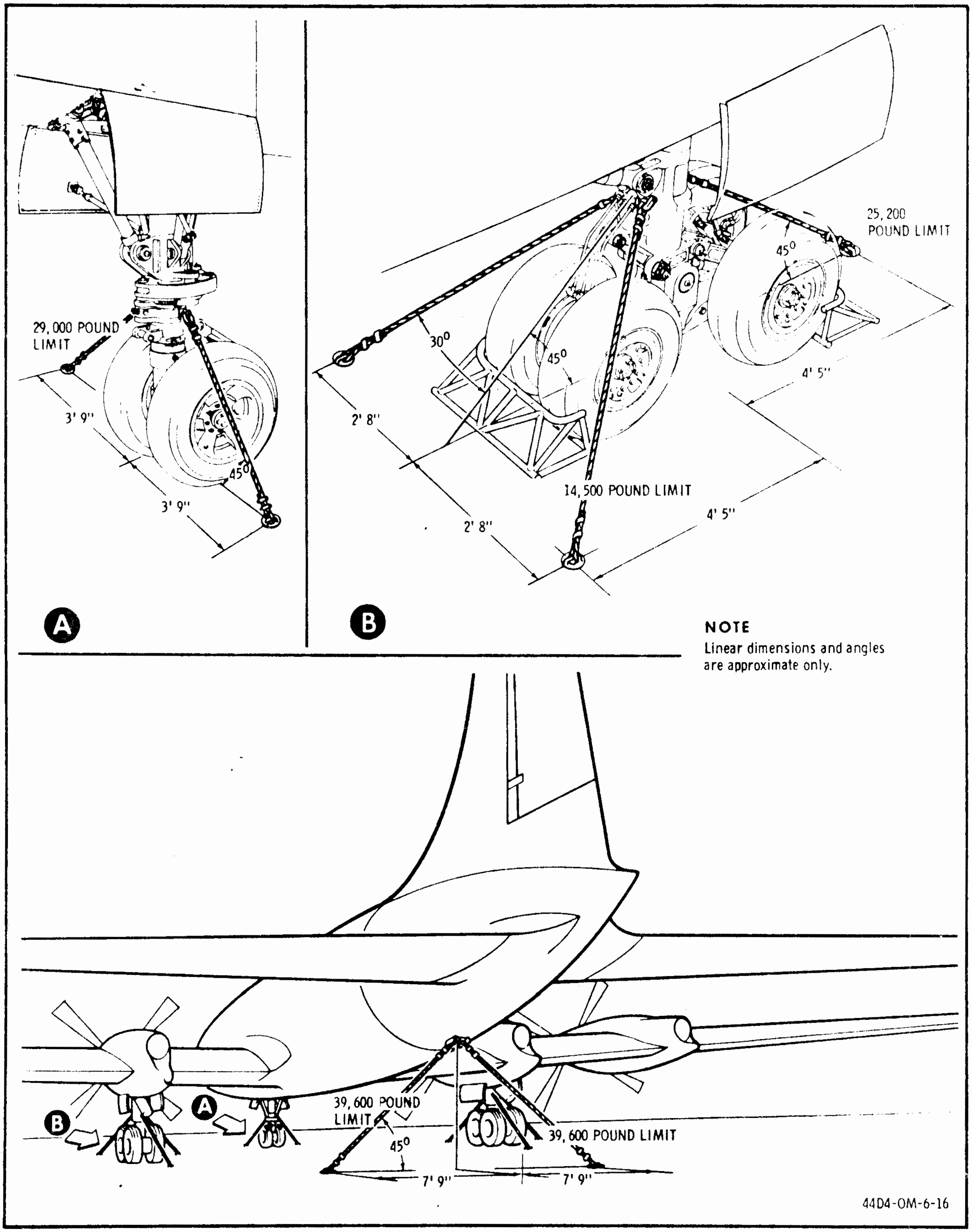
Typical Servicing Layout and Walkway Areas
Figure 10



EFFECTIVITY

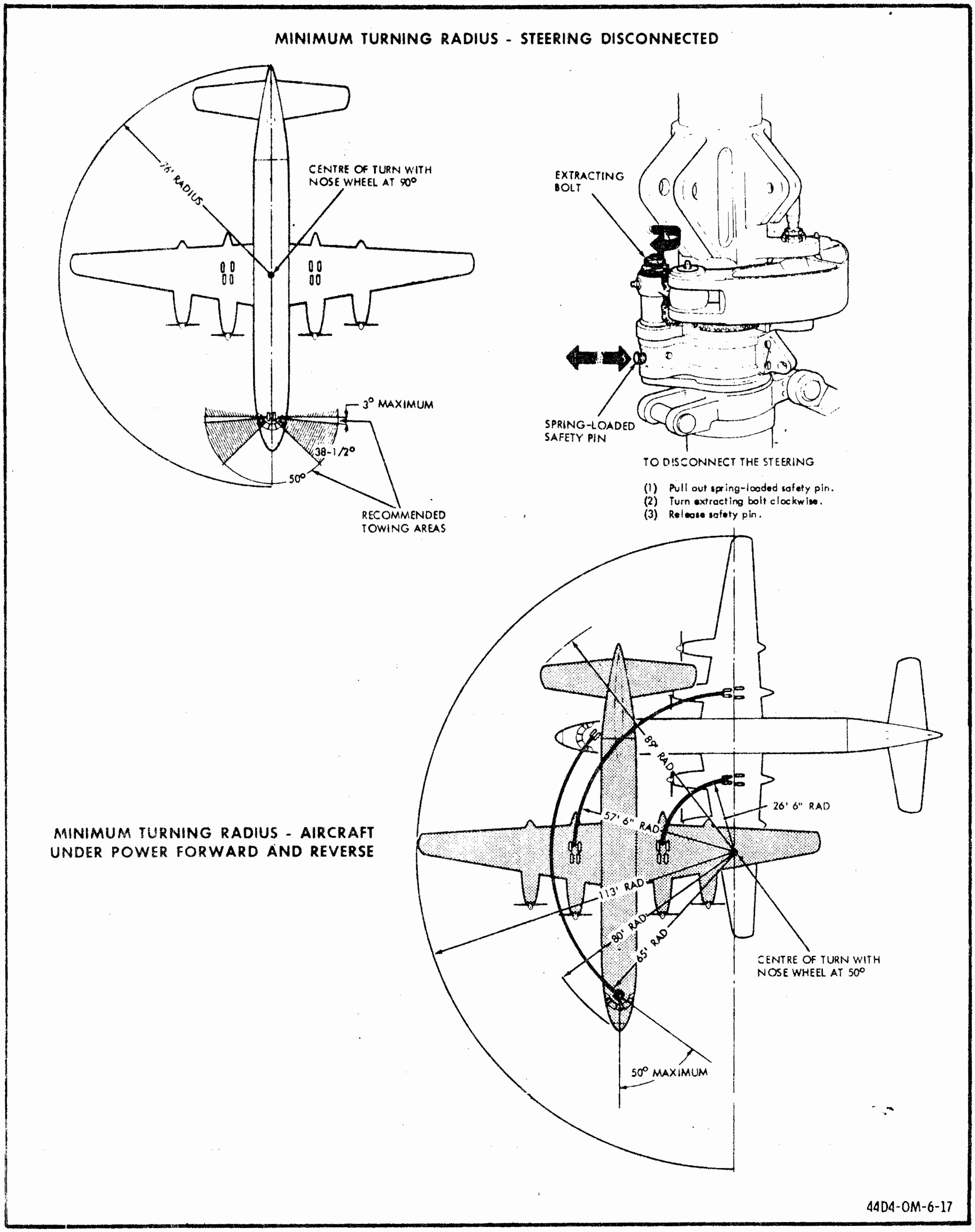
① AIRCRAFT 35 AND 36

Replenishing Points
Figure 11



NOTE
Linear dimensions and angles are approximate only.

Aircraft Tie-down Points
Figure 12



MINIMUM TURNING RADIUS - STEERING DISCONNECTED
76' RADIUS
CENTRE OF TURN WITH NOSE WHEEL AT 90°
3° MAXIMUM
38-1/2°
50°
RECOMMENDED TOWING AREAS
EXTRACTING BOLT
SPRING-LOADED SAFETY PIN

TO DISCONNECT THE STEERING

(1) Pull out spring-loaded safety pin.
(2) Turn extracting bolt clockwise.
(3) Release safety pin.

MINIMUM TURNING RADIUS - AIRCRAFT UNDER POWER FORWARD AND REVERSE
89' RAD
26' 6" RAD
57' 6" RAD
113' RAD
80' RAD
65' RAD
CENTRE OF TURN WITH NOSE WHEEL AT 50°
50° MAXIMUM
44D4-OM-6-17

Minimum Turning Radii
Figure 13

SECTION 7

AIR CONDITIONING

1. Air Conditioning

A. General

The air conditioning and pressurizing system is designed to supply pressurized fresh air, heated or cooled as required, to the main cargo and crew compartments. Temperature and pressure are automatically controlled but manual override is provided. The system is designed to maintain the inside temperature at approximately 70°F with outside temperatures ranging from -40° to 100°F and will effect a complete change of air in the cabin every 3-1/2 to 4 minutes under all flight conditions and at all heights up to 30,000 feet. Cold air is supplied through individually controlled outlets at the crew stations and in the toilet area. The aircraft can be air conditioned on the ground by an external ground air conditioning unit connected to the system or a limited amount of air conditioning may be obtained with either or both inboard engines running.

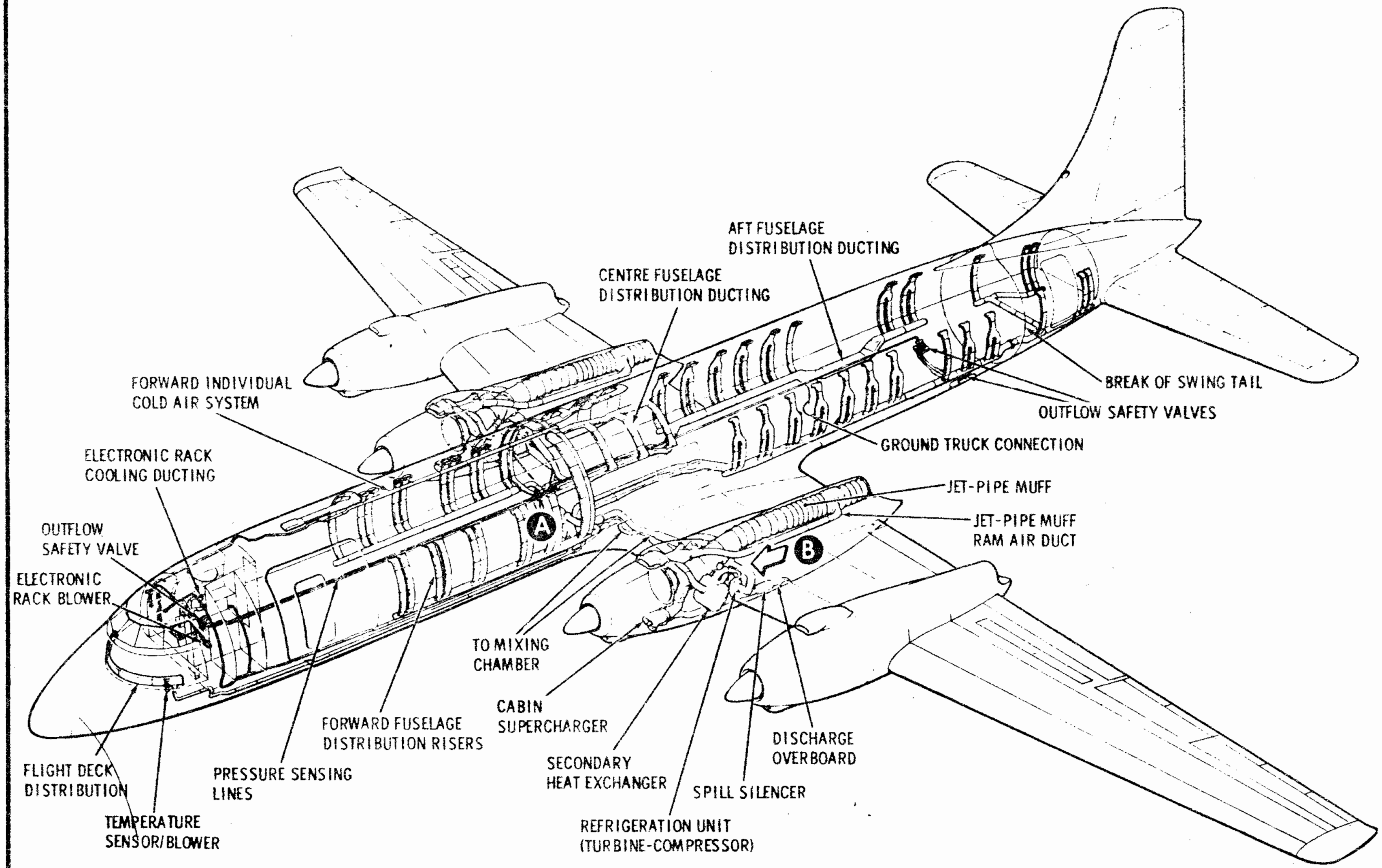
The cabin altitude control system enables sea-level pressure to be maintained up to an aircraft altitude of approximately 15,000 feet. At this height, the cabin differential pressure is at its maximum of 6.55 psi. Above 15,000 feet, this differential is maintained so that at an aircraft height of 30,000 feet, cabin altitude is equivalent to 8,000 feet.

For a diagram of the air conditioning and pressurizing system, refer to Figure 1.

Each inner nacelle contains a cabin supercharger, spill control system, jet-pipe muff, primary heat exchanger, refrigeration unit (which includes a secondary heat exchanger), water separator, air flow modulating valves and a turbo-fan ground blower. The output of each nacelle system is delivered to a common manifold. Failure of one inboard engine would halve the normal system output. For a schematic of the air conditioning system, refer to Figure 2.

B. Superchargers

The superchargers are positive-displacement compressors, mounted on and driven by the accessory gear-boxes of each inboard engine. Each

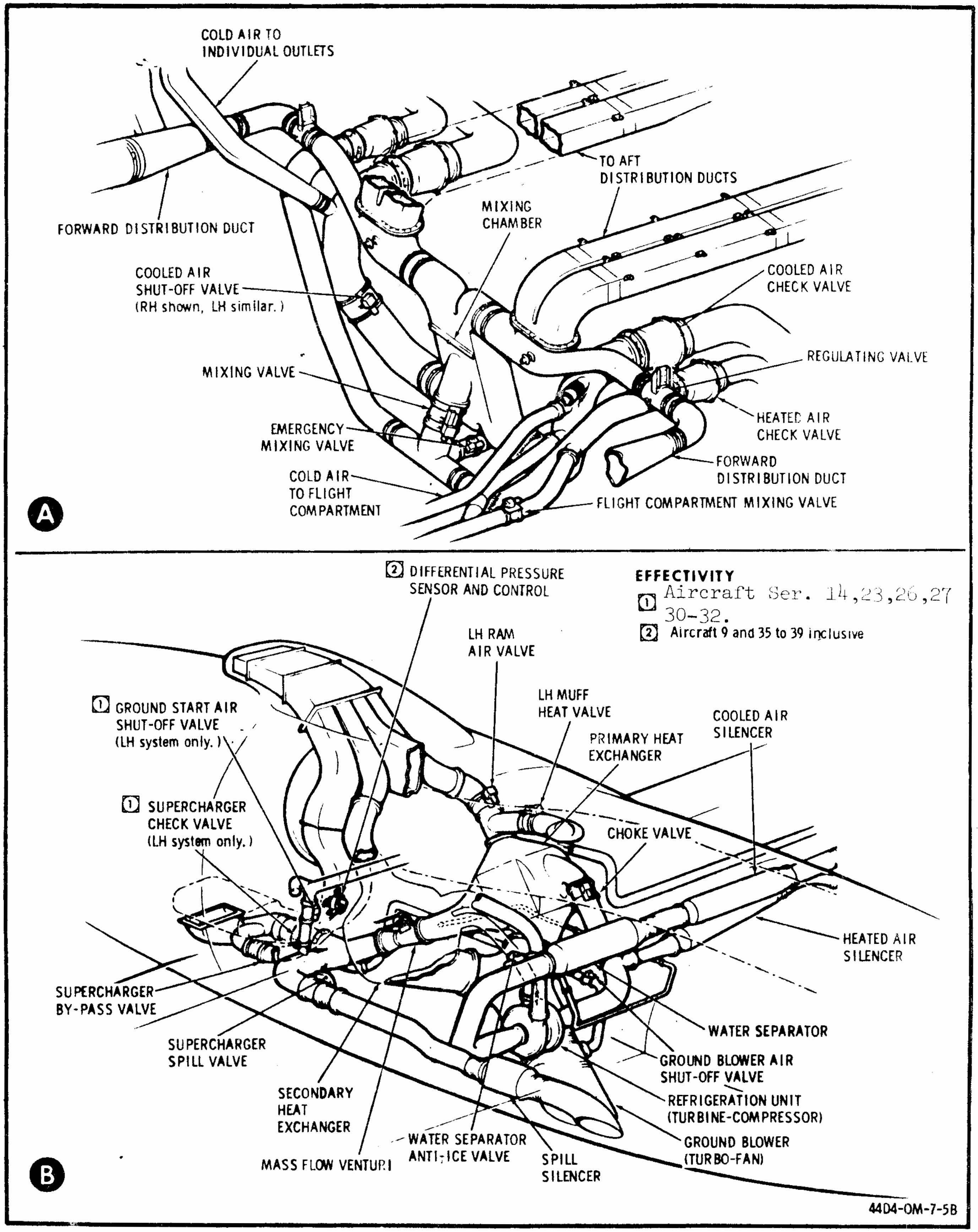

AFT FUSELAGE DISTRIBUTION DUCTING
CENTRE FUSELAGE DISTRIBUTION DUCTING
FORWARD INDIVIDUAL COLD AIR SYSTEM
BREAK OF SWING TAIL
OUTFLOW SAFETY VALVES
GROUND TRUCK CONNECTION
ELECTRONIC RACK COOLING DUCTING
JET-PIPE MUFF
JET-PIPE MUFF RAM AIR DUCT
OUTFLOW SAFETY VALVE
A
B
ELECTRONIC RACK BLOWER
TO MIXING CHAMBER
CABIN SUPERCHARGER
FORWARD FUSELAGE DISTRIBUTION RISERS
DISCHARGE OVERBOARD
SECONDARY HEAT EXCHANGER
FLIGHT DECK DISTRIBUTION
PRESSURE SENSING LINES
SPILL SILENCER
TEMPERATURE SENSOR/BLOWER
REFRIGERATION UNIT (TURBINE-COMPRESSOR)

NOTE

For Detail A and View B see Sheet 2.

44D4-OM-7-1A

Air Conditioning and Pressurizing System Diagram
Figure 1 (1 of 2)

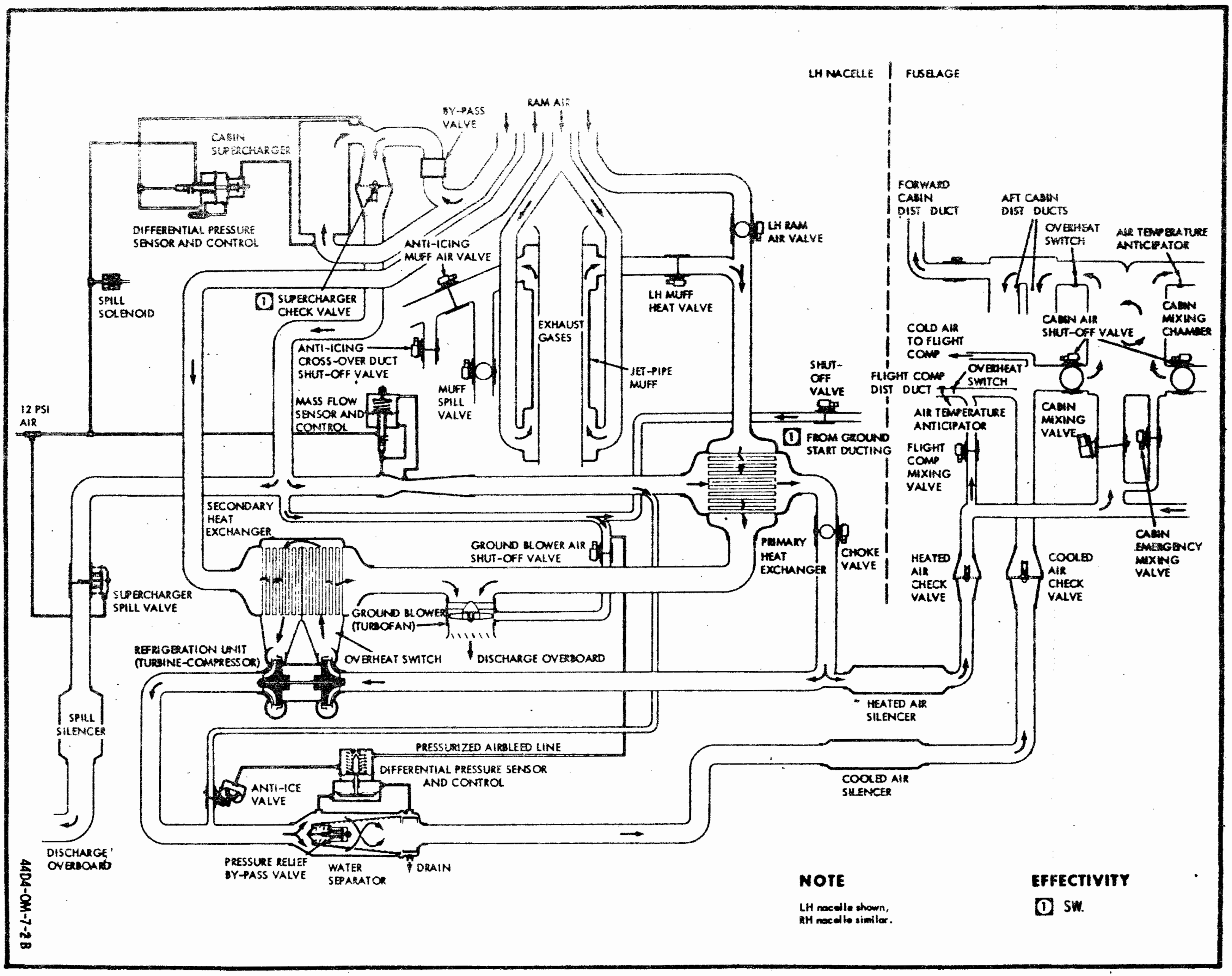


EFFECTIVITY

① Aircraft Ser. 14,23,26,27
30-32.

② Aircraft 9 and 35 to 39 inclusive

Air Conditioning and Pressurizing System Diagram
Figure 1 (2 of 2)



NOTE

LH nacelle shown,
RH nacelle similar.

EFFECTIVITY

① SW.

Air Conditioning and Pressurizing System - Schematic
Figure 2

supercharger is equipped with a hydraulically operated disconnect for emergency use and, once disconnected, cannot be re-connected in flight. Supercharger by-pass ducts supply ram air for conditioning in the event of failure or disconnection of both superchargers. The superchargers together are capable of delivering 200 pounds of air per minute at sea level and 120 pounds per minute at 30,000 feet.

C. Spill Control System

Supercharger differential pressure and mass flow are monitored by sensors which control the spill valves. These valves are operated by air from the aircraft main pneumatic system. The primary function of the spill valve is to ensure a controlled cabin airflow at varying pressure altitudes and engine speeds. The valve is held in the closed position by air pressure from the pneumatic system. Operation of either the differential pressure sensor or the mass flow sensor vents pneumatic pressure to atmosphere, allowing the spring-loaded spill valve to move towards the open position to permit supercharger air to be spilled overboard.

The differential pressure sensor protects the supercharger against excess back pressures which may result when the system operates in full refrigeration, and also provides protection against surging. Normal operation of the differential pressure sensor and the mass flow sensor can be overriden by a spill solenoid which is controlled by a switch on the system operators panel. When SPILL is selected on the switch, the solenoid is energized, venting the controlling pneumatic pressure to atmosphere and causing the spill valve to open, thereby diverting supercharger airflow overboard. In addition, the LH and RH spill solenoids are energized when engines No. 2 and No. 3 respectively are selected on the engine selector switch.

D. Control Valves

From the superchargers, the compressed air is delivered to the primary heat exhangers. If heat of compression is not sufficient to maintain the selected cabin temperature, the system air temperature is increased by directing hot air from the jet-pipe muff across the primary heat exchanger. This flow of hot air is controlled by a muff heat modulating valve operating in response to signals from the temperature control. The hot air supply from the jet-pipe muff is further controlled by the modulation of the muff spill valve. However, if wing anti-icing is switched on, the muff spill valves of the inboard engines will be controlled by the wing anti-icing temperature control systems.

If the heat of the compressed air is to be reduced, ram cooling air, supplied from the intakes, is directed across the primary heat exchanger. This cooling air is controlled by a ram air modulating valve responding to temperature control system signals.

If, after leaving the primary heat exchanger, no further cooling of the air is required, it is ducted through the heated air delivery line to the flight deck duct and to the mixing chamber. The flow of air to the flight deck duct is controlled by a modulating flight deck mixing valve and to the mixing chamber by a modulating cabin mixing valve. To provide an alternative route to the mixing chamber in the event of a failure of the cabin mixing valve, a by-pass duct is installed together with an associated cabin emergency mixing valve. Selection of the cabin emergency mixing valve is controlled from the systems operators station.

If, after leaving the primary heat exchanger, further cooling of the conditioned air is required, the flight deck and cabin mixing valves will, in response to signals from the temperature control systems, modulate towards the closed position, increasing the flow of air into the refrigeration unit and so through the cooled air delivery line.

E. Refrigeration Unit

The refrigeration unit consists of a self-driven turbine-compressor and a secondary heat exchanger. The air enters the compressor, where its temperature and pressure are increased, and is then directed through the heat exchanger where it is cooled by air obtained from the intakes. The ram cooling air for the secondary heat exchanger is not modulated. From the secondary heat exchanger, the air enters the turbine where it is allowed to expand with a resultant temperature drop. The energy of the expanding air drives the turbine and, through a common shaft, the compressor. Sensors located in the turbine input ducts will illuminate indicator lights on the systems operators panel if an overheat condition occurs.

F. Water Separator

After leaving the refrigeration unit, the air is directed through a water separator where moisture particles are collected. Accumulated water is drained overboard via a drain fitting in the separator. The water separator incorporates a differential pressure sensor which controls an anti-icing valve. Any icing occurring in the separator will create an increase in the differential pressure across the separator, causing the sensor to open the anti-icing valve to admit supercharger-heated air to melt the ice.

From the water separator the air is ducted through the cooled air delivery line to the mixing chamber where it combines with the heated air delivery line output. The conditioned air is ducted from the mixing chamber to the cabin and exhausted from there to the below-floor area where it is discharged overboard through three outflow valves. To reduce air-flow noise level, the heated and cooled air delivery lines and the supercharger spill lines incorporate silencers.

Small branch ducts off the cooled air delivery line feed cooled air to individually controlled outlets at the crew stations and in the toilet area.

2. Temperature Control Systems

Temperature of the conditioned air is controlled by two electrical control systems, one for the flight deck and one for the cabin. Each system can be controlled automatically or manually.

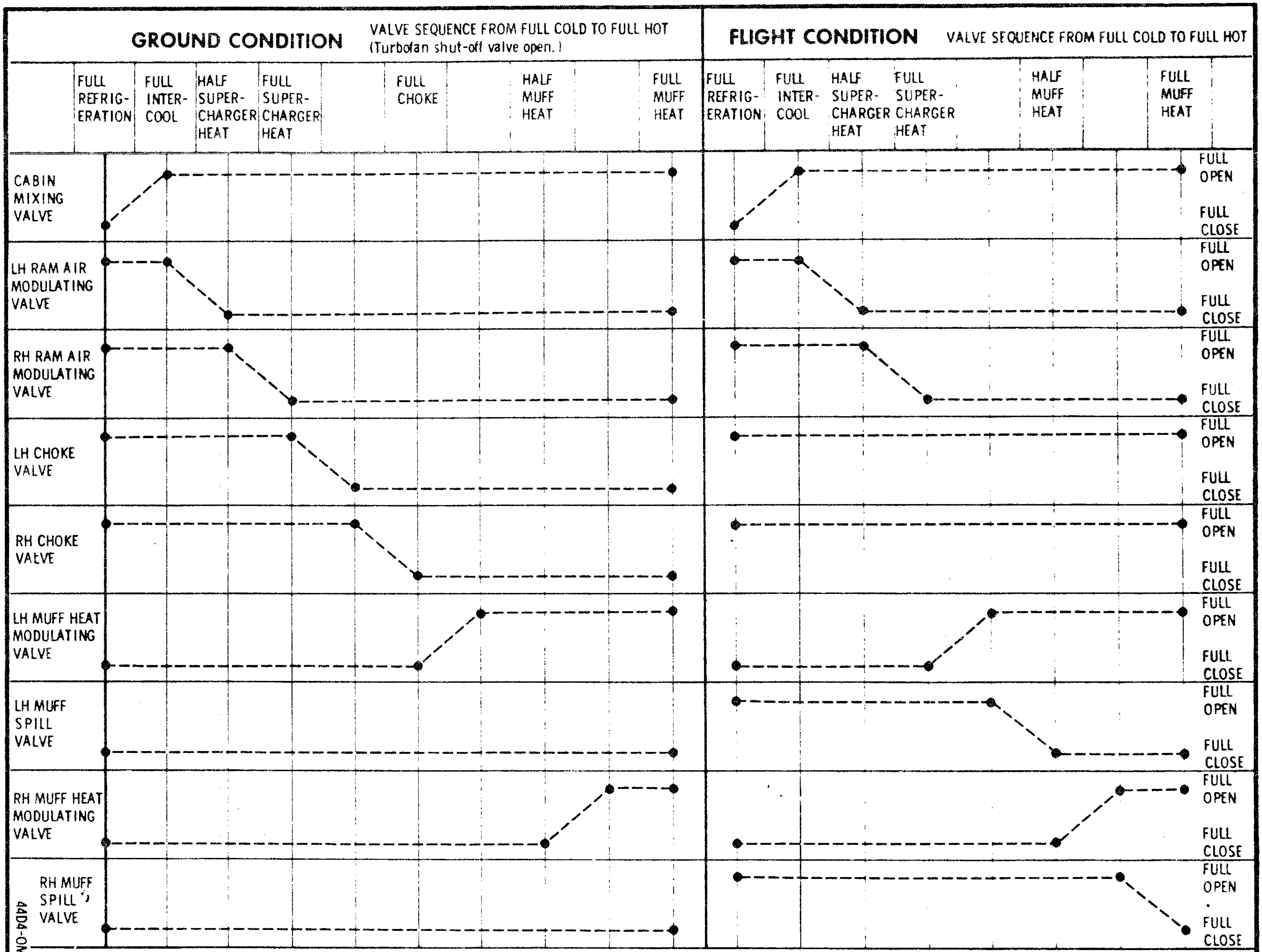
The automatic temperature control units are of the magnetic-amplifier type and incorporate a Wheatstone bridge circuit. If the compartment is at the selected temperature, the bridge will be balanced. Any variation in compartment temperature, a sustained change in the distribution duct air temperature, or a different temperature selection will cause an imbalance in the bridge circuit. The imbalance will cause the operation of relays to transmit modulated control-voltage pulses to produce the correct control valve operating sequence for either a heating or a cooling cycle. The length of a modulated control-voltage pulse will vary directly with the degree of imbalance in the bridge circuit.

A. Cabin Temperature Control

Under flight conditions, the cabin temperature control system controls seven valves. The valves operate in a fixed heating or cooling sequence. In the heating cycle, the valve operating order is as follows; cabin mixing, LH ram air, RH ram air, LH muff heat, LH muff spill, RH muff heat, RH muff spill (Ref. Fig. 3). In the cooling cycle, the order of operation is reversed. Only one valve at a time operates; if its limit is attained, - open or closed, a limit switch will permit the next valve in the sequence to operate.

Five valve position indicator windows on the systems operators panel are associated with the valves. As each valve reaches its limit, the appropriate indicator will be energized by the control-voltage pulse and will illuminate. The windows marked LH MUFF HT and RH MUFF HT will illuminate only when both the related muff heat and muff spill valves reach their limits. However, should wing anti-icing be switched on, the muff spill valves are automatically disconnected from the air conditioning temperature control and are controlled by the wing anti-icing systems.

If a control valve fails, operation of the respective valve isolating switch on the systems operators panel will isolate the valve and permit bypassing of electrical power to the next valve in sequence. Should the cabin mixing valve fail, the emergency cabin mixing valve may be selected and will be controlled in the normal sequencing of the control valves.



NOTES 1 Muff spill valves remain closed while aircraft is on ground.

2 When anti-icing system is operating, control of muff spill valves is transferred to anti-icing control circuit.

Air Conditioning System - Control Valve Operating Sequence
Figure 3

If automatic temperature control fails, manual override is provided. Selection of either HEAT or COOL on the temperature system control switch will by-pass the automatic control and apply a steady voltage to the control circuit.

B. Flight Compartment Temperature Control

The flight compartment temperature control system normally operates in a similar manner to that of the cabin system but, due to the relatively small area of the flight compartment, controls only the flight compartment mixing valve. If, however, a cargo compartment fire occurs and the cabin air valves switch is placed to CLOSED, the sequencing of the control valves is transferred from the cabin temperature control system to the flight compartment temperature control system.

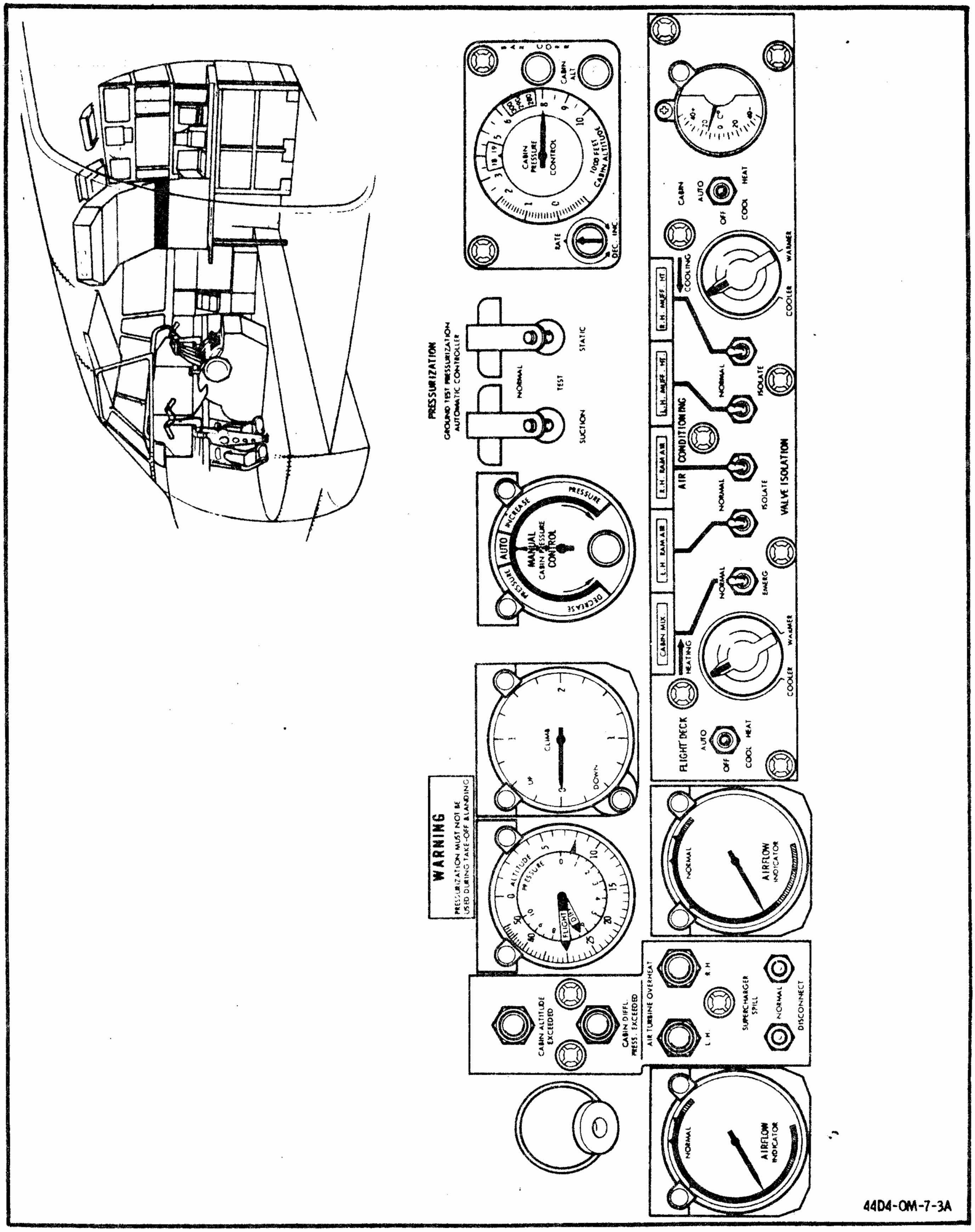
Two adjustable deflector-type outlets located in the roof aft of the pilots overhead panel and one adjustable deflector-type outlet above the toilet door provide additional conditioned airflow to the flight compartment. Air is diverted to these outlets by means of a selector valve, marked FLOOR-AIR COND SUPPLY-ROOF, located adjacent to the weather radar indicator.

C. Limit Switches

Limit switches are installed in the flight compartment distribution duct and in the cabin distribution duct. If a distribution duct air temperature exceeds the setting of the switch, the current to the related automatic control unit is disconnected and a constant cold signal is transmitted to the associated control valves until the temperature falls below the switch setting.

3. Ground Air Conditioning

To maintain continuity of air conditioning when the aircraft lands and to operate the system when the aircraft is on the ground, a choke valve, ground blower air shut-off valve, turbo-fan ground blower and ground blower duct are installed in each nacelle ducting system. In flight, the choke valves remain in the open position and the ground blower air shut-off valves in the closed position. When the weight of the aircraft is on the landing gear, the ground safety relay introduces each nacelle choke valve into the control valve sequence and simultaneously opens each ground blower air shut-off valve. The LH and RH choke valves are included in the control valve sequence between the RH ram and LH muff heat valves. Modulation of the choke valves towards the closed position during the heating cycle restricts the flow of air from the supercharger to raise the heat of compression. Operation of the turbo-fans will draw air across the primary and secondary heat exchangers and so compensate for the loss of normal in-flight ram air. In addition to the above, the muff spill valves will close when the aircraft is on the ground. The aircraft can also be air conditioned on the ground by an external air conditioning unit which introduces conditioned air to the distribution ducts



Air Conditioning and Pressurizing System Control Panel
Figure 4

through a ground connection. The air is prevented from entering the nacelle ducting systems by flapper-type check valves located downstream of the silencers in the heated air and cooled air ducts.

On aircraft Ser. No. 14, 23, 26, 27, 30-32, facilities are provided to permit ground air conditioning of the aircraft by an external source of unconditioned air when the engines are shut down. A three inch duct is installed in the left-hand inboard nacelle branching from the ground air start line to the duct downstream of the supercharger. The three inch duct contains a shut-off valve which, when electrical connections are installed, will permit air from the external ground starter unit to enter the left-hand nacelle ducting system and provide a limited amount of air conditioning.

4. Fire Control

To stop the flow of air to the cabin in the event of a compartment fire, an air shut-off valve is installed upstream of the mixing chamber in each of the cooled air delivery lines. The valves are controlled by a guarded cabin air valves switch, marked CLOSED-NORM, on the cabin smoke control panel at the systems operators station. Placing the switch to CLOSED will close both shut-off valves, the emergency cabin mixing valve and the cabin mixing valve, and will transfer the sequencing of the control valves to the flight compartment temperature control system. If the switch is returned to NORM, the shut-off valves, emergency mixing valve and cabin mixing valve will open. Before placing the switch to NORM, the CABIN MIX switch should be placed to EMERG momentarily to break the circuit.

5. Air Conditioning Operating Controls and Indicators

All operating controls and indicators for the air conditioning system are on the systems operators lower panel (Ref. Fig. 4). Two supercharger air flow indicators are provided, one for each supercharger. Each supercharger if controlled by a three-position switch, marked SPILL, NORMAL, DISCONNECT. In the SPILL position, the spill solenoid will be energized and so cause the spill valve to open. Placing the switch to DISCONNECT will disconnect the supercharger from the engine.

NOTE: Discretion should be exercised in using the DISCONNECT position of the supercharger control switch, as reconnection is not possible during flight and involves the removal of the supercharger and the replacement of the drive-shaft.

The flight compartment and cabin temperature control systems each have their own four-position control switch, marked AUTO, OFF, COOL, and HEAT. The COOL and HEAT positions are spring loaded to the OFF position. When a switch is in the AUTO position, the applicable system will be under automatic control and the temperature will be maintained at that selected by the temperature selector adjacent to the switch. Manual control is effected by toggling the control switch to the COOL or HEAT position. This action will override the automatic control and rapidly and sequentially operate the control valves. Main cabin temperature is recorded on the temperature indicator to the right of the cabin control switch. Care must be exercised by the systems operator to ensure that temperature overshoot does not occur when the manual override positions are used in conjunction with temperature indicator monitoring.

A normal-isolate switch is provided for each ram air valve and each muff heat valve to isolate the valve and permit an electrical by-pass to the next valve in sequence. The cabin mixing valve switch, marked NORMAL-EMERGENCY, permits the selection of the cabin emergency mixing valve. An identifying window above each valve switch will illuminate when the respective valve limit is attained. The indicator illuminating sequence is from left to right for heating and vice versa for cooling. The temperature change may be such that not all the control valves will be energized and, in this event, the last valve in the sequence to be fully operated will be indicated by its illuminated window. Since the indicator windows will only illuminate during the transmission of a control voltage pulse, it will be seen that as the cabin temperature nears the selected value, the length of the voltage pulse and consequently the frequency of window illumination will progressively decrease.

NOTE: During normal system operation, a dim glow will appear in the CABIN MIX window whenever the LH ram air valve is opening. This indication is easily distinguished from the normal lamp brilliance. If the LH ram air valve is isolated, the indication will appear when the RH ram air valve is opening.

Warning of an overheat condition in the turbine inlet ducts of the refrigeration units is provided by the appropriate LH or RH AIR TURBINE O/HEAT amber warning light.

6. Pressure Control

Pressurization is maintained by regulating the outflow of system air through outflow-safety valves. The system consists of three outflow-safety valves, a cabin pressure controller, a manual controller, warning devices and jet pumps. The units are connected by pneumatic lines and air filters are incorporated where needed. The system is controlled from the systems operators panel.

A. Outflow-safety Valves

Three outflow-safety valves are installed, one at the front end of the forward hold and two at the rear end of the aft hold. If an outflow valve malfunctions, it is designed to fail safe to the closed position, the other two valves being capable of maintaining control of cabin pressure. Each valve incorporates positive and negative pressure relief features. A low pressure limit control is also incorporated so that if cabin altitude rises to 13, 000 (±2000) feet the outflow valves will automatically close. The outflow valves are controlled automatically by the cabin pressure controller and manually by the manual controller.

B. Cabin Pressure Controller

The cabin pressure controller is a pressure regulator which supplies a reference pressure to the control chambers of the outflow valves in accordance with a predetermined pressure setting. The unit thus maintains in the outflow valve control chambers either a constant pressure for isobaric control or a constant control chamber-to-atmosphere differential pressure at aircraft altitudes above the isobaric limit.

C. Manual Controller

The manual pressure controller is used to increase or decrease cabin pressure when it is necessary to by-pass the automatic controller. The unit does not by-pass the pressure controller when increasing cabin pressure above the isobaric limit.

D. Jet Pumps

To assist the operation of the outflow valves, a jet pump is incorporated in each outflow valve and an additional jet pump is provided for manual and automatic control operation. The jet pumps are operated by the engine bleed pneumatic system when the pneumatic system control switch is placed at STBY PUMP 1 or STBY PUMP 2, and cause a reduced reference pressure in the control system. This assists in opening the outflow valves, when cabin-to-ambient differential pressure is low, to avoid engine start-up pressure bumps and to enable equalization of cabin altitude and aircraft altitude.

E. Pressurizing Controls and Indicators

The pressurizing controls and indicators are located on the systems operators lower panel (Ref.Fig.4), and consist of a cabin pressure controller, a manual pressure controller, a cabin rate-of-climb indicator, a cabin altitude/pressure differential indicator, two warning lights and two ground test switches. The cabin pressure controller mounts two main controls, an altitude control for the selection of desired cabin altitude, and a rate control for setting the rate of cabin pressure change. The RATE control knob sets a rate of climb or descent of approximately 300 feet per minute when the knob arrow is on the index. An auxiliary control is provided to correct the cabin altitude setting in accordance with barometric pressure.

Use of manual controller will by-pass the automatic controller reference pressure line and override the automatic control. The dial is marked DECREASE PRESSURE, AUTO, and INCREASE PRESSURE. Normally the needle, which is positioned by the control knob, is in the AUTO range and pressure regulation is under automatic control. Turning the needle to the INCREASE PRESSURE or the DECREASE PRESSURE segments will manually control operation of the outflow valves, the degree of needle deviation from the AUTO segment varying the rate of pressure change. The three needles on the cabin altitude/pressure differential indicator read aircraft altitude, cabin altitude and cabin-to-atmosphere differential pressure on their respective scales.

An amber caution light referring to cabin altitude and a red warning light referring to cabin differential pressure are provided. If the cabin differential pressure rises above 7.2 psi or the cabin altitude reaches 8750 (±250) feet, the appropriate light will illuminate. Illumination of the cabin differential pressure warning light will be simultaneously accompanied by the illumination of the CAB DIFF PRESS windows on the pilots annunciator panels and by the flashing of the master warning lights.

To permit ground testing of the system, two guarded normal-test switches are provided. These switches are not used by the flight crew for normal or emergency operation of the system.

7. Power Sources

The circuit-breakers and power sources for the pressurizing and air conditioning system are as follows:

(1) Constant-frequency A.C. Bus B	Quantity
Flt Deck Temperature Control	1
Air Cond. Control	1
(2) D.C. Main Bus	
Air Conditioning - Control - Master	1
Air Conditioning - Control - Flight Deck	1
Air Conditioning - Control - Ground	1
Air Conditioning - Valve Isolation	1
Air Conditioning - Temp Indicator	1
Wing Anti-icing - Modulator and Spill Valves - LH Inboard	1
Wing Anti-icing - Modulator and Spill Valves - RH Inboard	1

	Quantity
Wing Anti-icing Air Cond. Change Over Relay	1
(3) D.C. Essential Bus A	
Cabin Smoke Control - Cabin Air Valves Override	1
Cabin Pressure - Diff Warning	1
Cabin Pressure - Alt warning	1
(4) D.C. Essential Bus B	
Air Cond. - Supercharger - Cont and Overheat Light LH	1
Air Cond. - Supercharger - Cont and Overheat Light RH	1
Air Conditioning - Duct Temp Limiting	1

SECTION 8

AUTO PILOT

1. Auto Pilot

A. General

The PB-20H automatic pilot system consists of electronic and electromechanical components which guide the aircraft on any selected heading and simultaneously stabilize it for pitch and bank. This is accomplished by detecting changes in the aircraft attitude with respect to a fixed reference, thereby producing error signals which are amplified and applied to the corresponding control surface servo motors. The servo motors give control surface tab movement in a direction which produces control surface movement to return the aircraft to the reference. The auto pilot can also be coupled with the integrated director system (IDS) and the Omega navigation system. See check list for Omega operation.

Depending upon the mode selected, the auto pilot receives signals which command it to control the aircraft in the following manner:

(1) Maintain heading and attitude.

(2) Make co-ordinated turn onto and maintain a preselected heading.

(3) Maintain a selected barometric altitude.

(4) Make co-ordinated turns onto selected ILS localizers.

(5) Maintain the correct angle of approach along an ILS guidepath.

The error signals generated in the various chains of the auto pilot are of two kinds, displacement signals and rate signals. Displacement signals are proportional to the deviation of the aircraft from the reference axes and are of a phase to return the aircraft to the reference. Rate signals oppose any change in the aircraft attitude and are proportional to the rate of change, thus providing a damping of the aircraft movement. No long term errors are permitted to remain in the system due to the action of the integrators which, over a period of time, build up a counter signal equal and opposite to the error signal.

B. Servo Motors

Three control surface servo motors are used to position the aileron, elevator and rudder servo tabs respectively. Each motor consists essentially of a two-phase induction motor driving a gear train, a solenoid-operated clutch and a rate generator. The clutch engages and disengages the servo motor from the gear train. The rate generator will prevent hunting of the servo motor by applying a negative feedback signal to the related signal chain, resulting in the damping of the servo motor operation. The output drive of each servo motor is connected, through a mechanical disconnect, to the bevel gear-box of the related control unit in the flight control system (Ref. Sect. 11).

An elevator trim servo motor is mechanically connected, through a friction clutch, to the mitre gear-box of the elevator trim flight control system (Ref. Sect. 11). The friction clutch is set to slip at a certain torque value which can be applied through the elevator trim handwheels. In order that a continuous pitch trim error load is not carried by the elevator servo motor, the elevator trim servo motor also receives the out of trim signal from the elevator signal chain. This signal rotates the trim servo motor at a rate proportional to the load to position the elevator trim tabs so that the loading on the elevator servo motor is relieved.

2. Controls and Indicators

Disconnect switches are located, one on each control column, for quick electrical disengagement of the system. A manual disconnect lever is provided on the pilots control pedestal for mechanical and electrical disengagement of the system. A warning system indicates when power is not applied to the auto pilot by the illumination of the windows on the annunciator panels marked AUTO-PILOT FAIL, and the flashing of the master caution lights.

A three-axis trim indicator is mounted on the pilots centre instrument panel. A manoeuvring controller and a function selector are both located on the control pedestal (Ref. Sect. 6).

A. Three-axis Trim Indicator

The three-axis trim indicator is a direct-reading panel mounted instrument. In the stand-by mode, the indicator shows synchronization of the signal chains. When the auto pilot is engaged, it shows out of trim conditions according to the amount and direction of servo displacement signals which are generated to keep the control surfaces in a position to maintain the aircraft heading and attitude.

B. Manoeuvring Controller

The pilots manoeuvring controller is mounted on the control pedestal and consists of a turn control knob and a pitch control wheel. By use of the controller while monitoring automatic flight control of the aircraft, the pilot can make alterations in direction and attitude, or correct any deviation to those already set up.

When the turn control knob is rotated either way from the centre detent, the compass direction signal is interrupted and a turn command signal is transmitted to the rudder and aileron control chains and from there to servo motors. The turn command signal is maintained until the control knob is returned to the centre detent.

Rotation of the pitch control wheel transmits a command signal to the elevator control chain, in a similar manner to that of the turn command. The elevator trim tab servo motor receives the same command signal and operates the elevator trim to remove residual aerodynamic loads. This feature ensures that the aircraft is in trim when the auto pilot is disengaged.

C. Function Selector

The function selector consists of five switches. The switches are of the solenoid type, and will not remain in the on position if the system is not energized, the pilots disconnect lever is moved out of detent, or if either the pilots or co-pilots release button is depressed. The switches are marked ENGAGE, ALTITUDE, SET HDG, LOCALIZER, and GLIDEPATH The ENGAGE switch must be on to operate any of the other mode switches

3. Operating Modes

The auto pilot is at stand-by two minutes after power has been placed on the system. During this warming up period, the vertical gyro will reach operating speed and automatic synchronization of the auto pilot and the control surfaces will be achieved. This will be indicated on the three-axis trim indicator when all three axes are lined up with the indices. A time delay relay prevents the ENGAGE switch from being operated until the expiration of the warming up period.

A. Engage Mode

Upon engagement, all servo clutches are engaged and a heading signal is applied to the auto pilot from the pilots compass system. The aircraft will then take up and follow the heading on which the aircraft was flying at the time of engagement.

B. Altitude Mode

In the altitude mode, the aircraft will be maintained at the barometric altitude prevailing at engagement, provided the pitch is within 10° of level flight. When altitude mode is selected, the manoeuvring controller pitch wheel is declutched.

C. Set Heading Mode

Automatic turn control is effected by preselecting the desired heading on the integrated director system and by operating the SET HDG switch on the function selector. When SET HDG is operated, the compass reference signal is interrupted and the preset heading output from the integrated director system causes the auto pilot to turn the aircraft to the new heading. With SET HDG engaged, the auto pilot will follow and turn the aircraft with movement of the heading selector. SET HDG cannot be selected unless the function selector engage switch is on and the manoeuvring controller knob is in the detent.

D. Approach Modes

Selection of the localizer mode provides the auto pilot with command signals from the integrated director system (IDS). Since the localizer and preset heading modes are both a function of IDS, neither can be selected while the other is engaged nor can either be selected if the turn control knob of the manoeuvring controller is out of detent.

When an instrument landing system (ILS) localizer frequency is tuned and the approach horizon is set to ILS, the beam error signals produced within the IDS are such that the auto pilot controls the aircraft on the localizer beam.

The GLIDEPATH mode can only be engaged when the localizer mode is engaged and is automatically disengaged if the localizer mode is disengaged. In addition to the beam error signals from the IDS, information from the glideslope receiver is directed to the IDS which produces a signal in the auto pilot elevator signal chain. This signal commands down elevator so that the aircraft enters the glideslope beam and is controlled to the correct angle of approach to the runway. When the glideslope mode is selected, the pitch control wheel is automatically disconnected.

4. Power Sources

The circuit-breakers and power sources for the auto pilot are as follows:

		Quantity
(1)	Constant-frequency Bus Panel A	
	Auto Pilot	3
(2)	D.C. Essential Bus Panel A	
	Auto Pilot	1

SECTION 9

ELECTRICAL

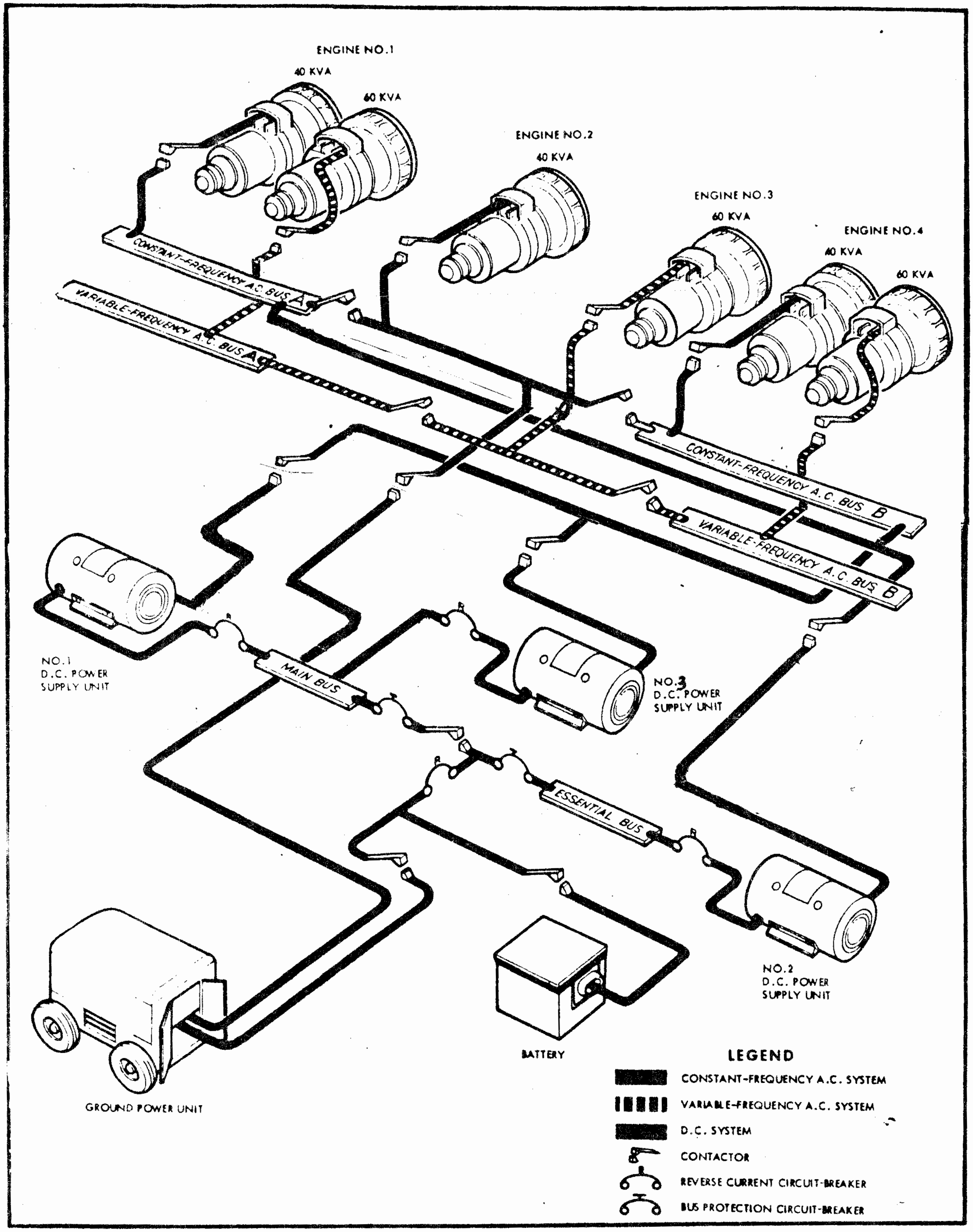
1. General

Electrical power for the aircraft services is supplied by a constant-frequency 200/115-volt 400-cycle 3-phase a.c. system, a variable-frequency 200/115-volt 3-phase a.c. system and a 28-volt d.c. system. Only a.c. power is generated in the aircraft, direct current being derived from two transformer-rectifiers which convert the constant-frequency a.c. to 28-volt direct current. A 24-volt storage battery provides an emergency source of d.c. power. Provision is made so that a supply of external constant-frequency a.c. ground power and d.c. ground power can be used on the aircraft buses. The complete electrical supply system for the aircraft is shown in its simplest form in Figure 1. For the location of the main electrical components, refer to Figure 2.

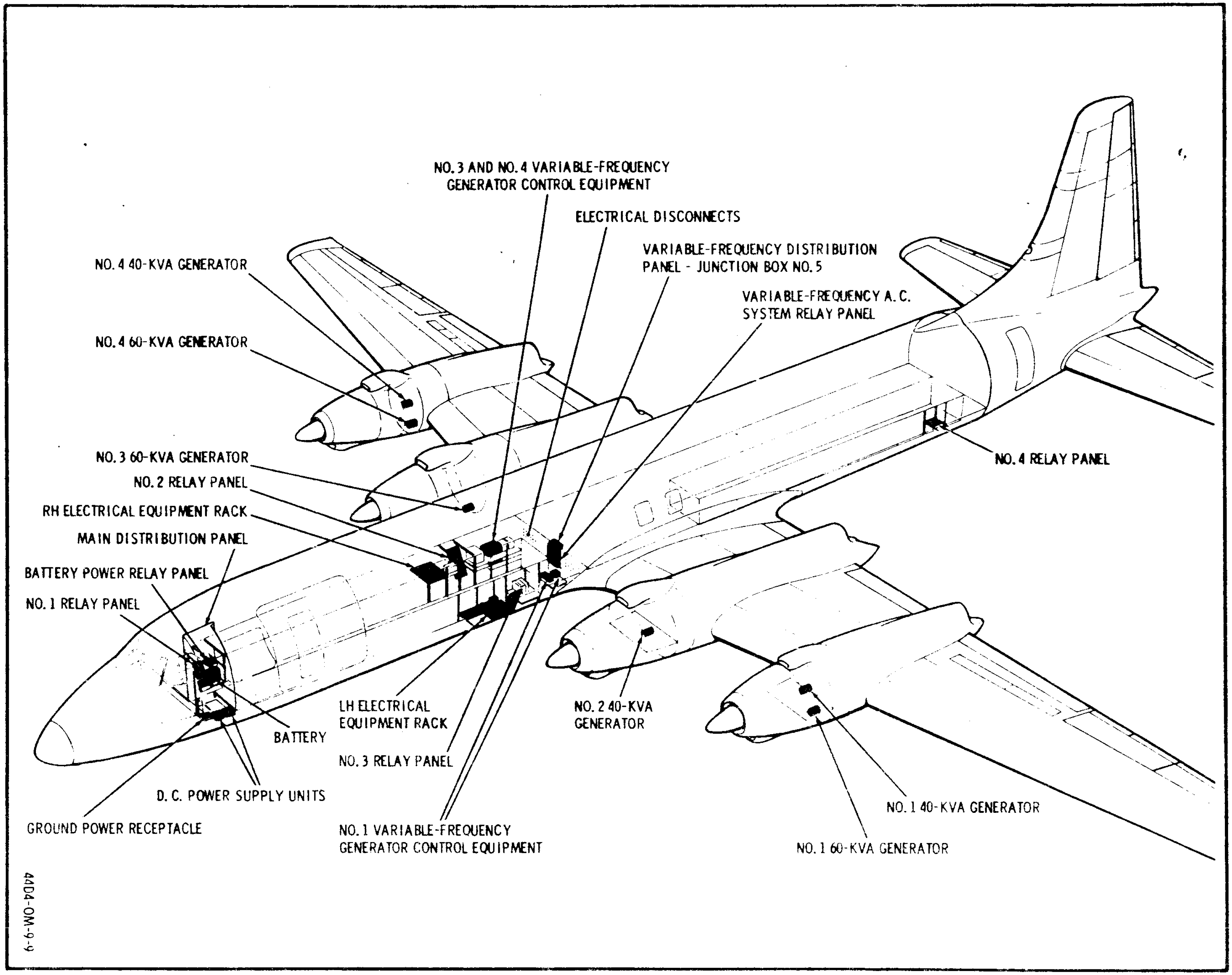
2. Constant-frequency A.C. Power System

The constant-frequency system is powered by three 40-kva a.c. generators driven through constant speed drives from engines No. 1, 2 and 4. The generators are not paralleled and under normal conditions with all generators running, generators No. 1 and 4 feed load buses A and B respectively, with No. 2 generator acting as a standby unit (Ref. Fig. 3). Two alternate bus tie relays connect the stand-by generator with the load buses. Control and fault protection is provided for the system and is automatic in operation. If a fault occurs on one or both generators normally in use, the stand-by generator automatically powers the load bus of the faulty generator. Should faults occur on the stand-by generator and No. 1 or No. 4 generator, and providing the fault is not on the load buses, the remaining generator automatically powers the two constant-frequency load buses.

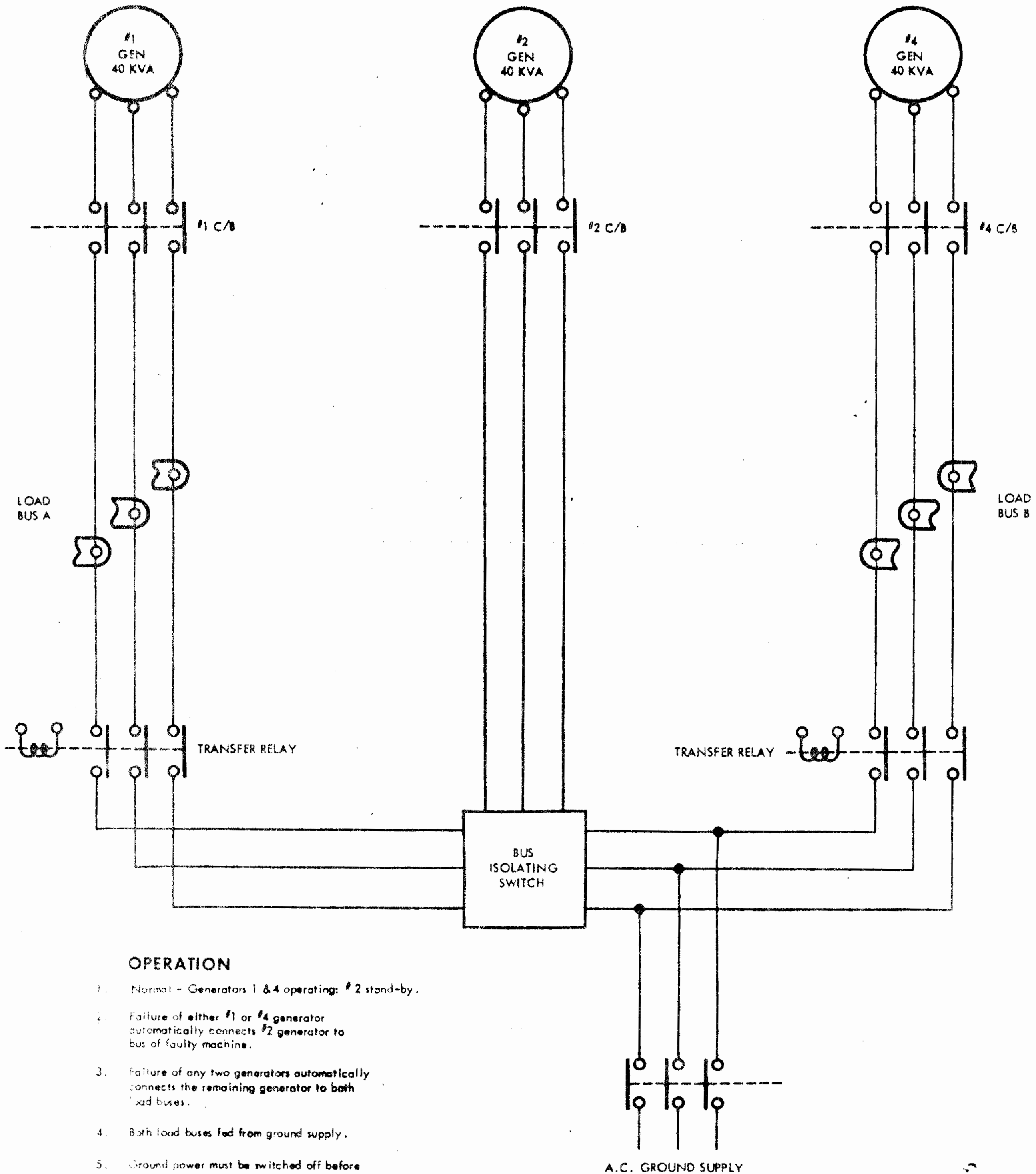
If a fault occurs on a load bus, e.g., load bus A, generator No. 1 and subsequently the stand-by generator will be tripped by their protection circuits. Generator No. 4 is automatically prevented from being connected to the faulted bus A by a bus isolating lock-out circuit. If the bus fault persists and generator No. 1 cannot be reconnected to load bus A, the faulted bus can then be isolated by operating the bus isolating switch at the systems operators panel. This permits the stand-by generator to be reset and be available to power load bus B should generator No. 4 be faulted. An identical circuit operates to protect the system should load bus B be faulted. The complete constant-frequency a.c. system consists of three such arrangements.


ENGINE NO.1
40 KVA
60 KVA
ENGINE NO.2
40 KVA
ENGINE NO.3
60 KVA
ENGINE NO.4
40 KVA
60 KVA
CONSTANT-FREQUENCY A.C. BUS A
VARIABLE-FREQUENCY A.C. BUS A
CONSTANT-FREQUENCY A.C. BUS B
VARIABLE-FREQUENCY A.C. BUS B
NO.1 D.C. POWER SUPPLY UNIT
MAIN BUS
NO.3 D.C. POWER SUPPLY UNIT
ESSENTIAL BUS
NO.2 D.C. POWER SUPPLY UNIT
BATTERY
GROUND POWER UNIT
LEGEND
CONSTANT-FREQUENCY A.C. SYSTEM
VARIABLE-FREQUENCY A.C. SYSTEM
D.C. SYSTEM
CONTACTOR
REVERSE CURRENT CIRCUIT-BREAKER
BUS PROTECTION CIRCUIT-BREAKER

Simplified Aircraft Electrical System
Figure 1



Main Electrical Component Location
Figure 2



OPERATION

1. Normal - Generators 1 & 4 operating: # 2 stand-by.
2. Failure of either #1 or #4 generator automatically connects #2 generator to bus of faulty machine.
3. Failure of any two generators automatically connects the remaining generator to both load buses.
4. Both load buses fed from ground supply.
5. Ground power must be switched off before any generator can be switched on.

Constant-frequency A.C. Generating System
Figure 3

A. Constant Speed Drive (CSD)

To maintain a constant frequency, it is necessary to operate the generators at a constant speed. This is accomplished by connecting the generator to the engine through a constant speed drive unit (CSD). The CSD operates hydraulically to convert any engine speed between approximately 55% LP rpm and 100% LP rpm to a constant 6000 (±60) rpm output to the generator. This speed corresponds to a line frequency of 400 cycles per second and is controlled by a governing and control mechanism on the CSD. A pressure-operated switch in the CSD controls an underspeed relay in the generator control panel. When the engine speed drops below approximately 52% LP rpm, the switch opens and, through the underspeed relay, trips the generator circuit-breaker to isolate the generator from the system. The pressure-operated switch also opens on an overspeed condition, tripping the generator from its bus. When the engine speed, and consequently CSD input speed, is subsequently reduced from the overspeed condition to the normal operating range, CSD governing is again resumed and the pressure-operated switch closes. This automatically reconnects the generator to its load bus. For a more detailed description of the CSD, refer to Section 17.

B. Constant-frequency A.C. Generators

Each constant-frequency a.c. generator is a 3-phase 208/120-volt 400-cycle machine rated at 40 kva with a power factor of 0.75. During flight, the generator is cooled by ram air and can deliver its rated load. When the aircraft is on the ground, cooling is provided by an internal fan only and the generator delivers a substantially lower output.

A d.c. generator, integral with the a.c. generator, provides power for excitation of the a.c. generator field. Excitation for the d.c. generator is supplied from the a.c. generator voltage regulator which controls the d.c. for the exciter field by using the output of the a.c. generator.

C. Generator Circuit-breakers

Each generator is connected to its load bus through a generator circuit-breaker, which is a multiple contactor with a close and a trip coil. The circuit-breaker is mechanically latched in the close position and is tripped to the free position. The close and trip functions of the circuit-breaker operate automatically under certain conditions or can be operated by the generator control switch on the systems operators panel.

D. Generator Control Panels

Each generator control panel contains relays and associated circuits used for protecting the system against fault conditions. The panel provides protection against overvoltage and undervoltage conditions, line-to-line, line-to-ground, and generator underspeed conditions. In addition to the various protection relays, the panel contains a generator control (GC) relay, the main function of which is to open and close the generator exciter field. The relay is a latch type with a trip and a close coil and has auxiliary contacts which are connected in the generator circuit-breaker trip coil circuit. This causes the circuit-breaker to open whenever the exciter field is opened. The GC relay can be reset or tripped by the generator control switch on the systems operators panel. On normal engine shut-down, the GC relay remains latched in the close position, eliminating the necessity for manual resetting on subsequent starts. If the generator has been tripped manually prior to engine shut-down, the generator control switch must be operated momentarily to the RESET position to bring the generator onto line on the next engine start-up.

The generator control panel also contains a transformer-rectifier for supplying its own d.c. control power. An alternative source of d.c. control power is supplied from the aircraft d.c. bus.

E. Bus Tie Relays

The bus-tie relays are heavy-duty contactors used for transferring a.c. power between stand-by generator No. 2 and load bus A and load bus B. Two bus-tie relays are used, one for each load bus. As long as generator No. 1 circuit-breaker remains closed, the bus-tie relay for load bus A is de-energized, and similarly for generator No. 4 circuit-breaker and the bus relay for load bus B. If either of these generator circuit-breakers trips, the corresponding bus-tie relay closes and connects the stand-by generator to the load bus of the tripped generator. The bus-tie relays are also used to transfer power between the load buses in the event of failure of the stand-by generator at the same time as one of the other generators. If a fault occurs on a load bus, its generator will trip and its bus tie relay will close, connecting the stand-by generator to the faulted bus. The stand-by generator will then trip and the bus-isolating circuit operate a lockout relay to de-energize the bus tie relay of the faulted bus before the remaining generator is tripped due to the bus fault. As the bus tie relay of the faulted bus is now de-energized, the remaining generator cannot be connected to the faulted bus and will continue to power its own load bus. The stand-by generator can then be reset. When a bus tie relay is energized, its green bus tie warning light on the systems operators panel will illuminate.

F. A.C. Ground Power

Constant-frequency a.c. ground power is connected to the aircraft at the external power receptacle. When ground power is plugged into the receptacle, voltage is fed directly to the ground power circuit-breaker which will close only when the phase sequence of the ground power is the same as that of the aircraft generating system. Ground power is routed from the ground power circuit-breaker to the aircraft bus tie circuit. Power to the ground power relay coil is fed from the ground power switch, at the systems operators station, when GPU is selected.

Operation of the ground power relay and the No. 2 generator circuit-breaker is interlocked. When the ground power relay is energized, it trips all the generator circuit-breakers. This circuit prevents the generator circuit-breakers from being closed at the same time as the ground power relay and ensures that only one source of power is on the bus tie at one time. Closed contacts in the tripped No. 2 generator circuit-breaker complete the circuit to the ground power circuit-breaker close coil. If the No. 1 and No. 4 generator circuit-breakers are open, the associated bus tie relays will be closed and ground power will feed the two load buses.

The ground power relay and the No. 1 and No. 4 generator circuit-breakers are also interlocked. When the a.c. ground power switch is selected to GPU and the ground power relay is closed, the generator circuit-breakers are tripped. This circuit ensures that the No. 1 and No. 4 generator output cannot be paralleled with ground power on the aircraft load buses. Selecting the ground power switch to OFF, with No. 1 generator up to cut-in speed, will allow No. 1 generator circuit-breaker to close and connect No. 1 generator output to load bus A.

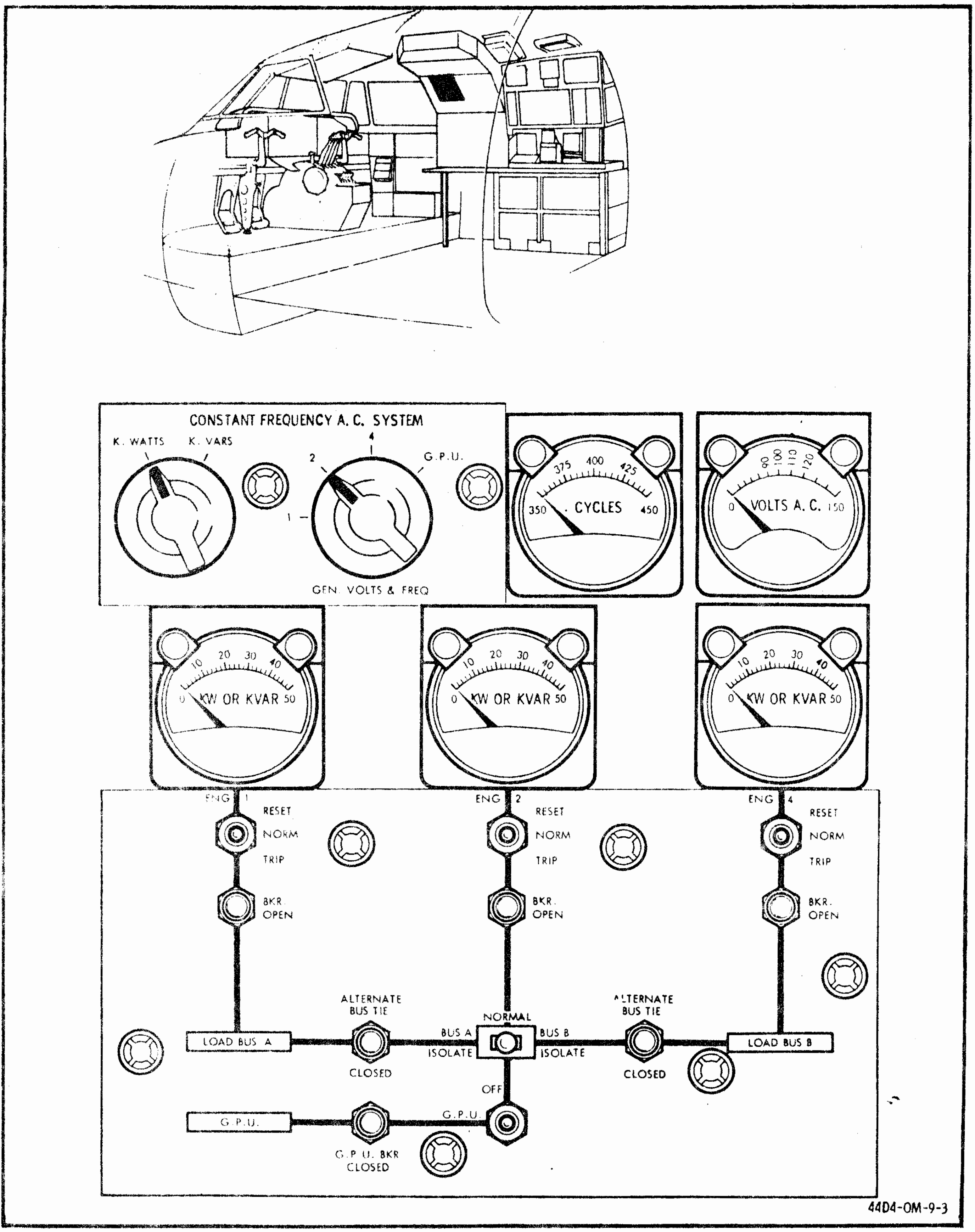
The control circuits for the a.c. ground power system are operated by 28-volt d.c.

G. Constant-frequency A.C. System Controls and Indicators

All constant-frequency a.c. system controls and indicators are located on the constant-frequency a.c. panel of the systems operators centre panel (Ref. Fig. 4).

The panel is engraved to represent the basic schematic of the system. The output from the generators is indicated by three watt-varmeters on the panel. The meters will read either real power in kilowatts (KWATTS) or reactive power in kilovars (KVARS). A rotary selector switch mounted above the No. 1 engine watt-varmeter selects either real or reactive power indication for all three meters. Two additional meters are installed to measure the voltage and frequency of each generator and the ground power unit (GPU). The two meters are switched together by an adjacent selector switch to indicate any single power source.

Each generator has a RESET-NORM-TRIP control switch with an amber indicator light located below the switch. The indicator light will illuminate whenever the generator circuit-breaker is tripped. The NORM position of



Constant-frequency A.C. System Controls - Systems Operators Station
Figure 4

a generator control switch is used throughout normal aircraft operation. Placing the switch to TRIP will energize the trip coil of the generator control relay in the generator control panel, thereby opening the generator exciter field and causing a complete cessation of generator power output. When the generator control relay trips, a supply is fed to the generator circuit-breaker trip coil thus causing the isolation of the generator from the system. Once a generator is manually tripped, the RESET position of the control switch must be used to bring the generator back on line. Both TRIP and RESET positions are spring loaded to the NORM position.

The bus isolating switch, marked BUS A ISOLATE-NORMAL-BUS B ISOLATE, is used to ensure isolation of a load bus which has a bus fault. The stand-by generator can then be reset and continue to function as a stand-by source of power for the remaining unfaulted load bus. As a safety feature, the toggle of the switch must first be pulled out before it can be moved to another position. A green indicator light, marked ALTERNATE BUS TIE CLOSED, on each side of the bus isolating switch will illuminate when the related bus tie relay closes.

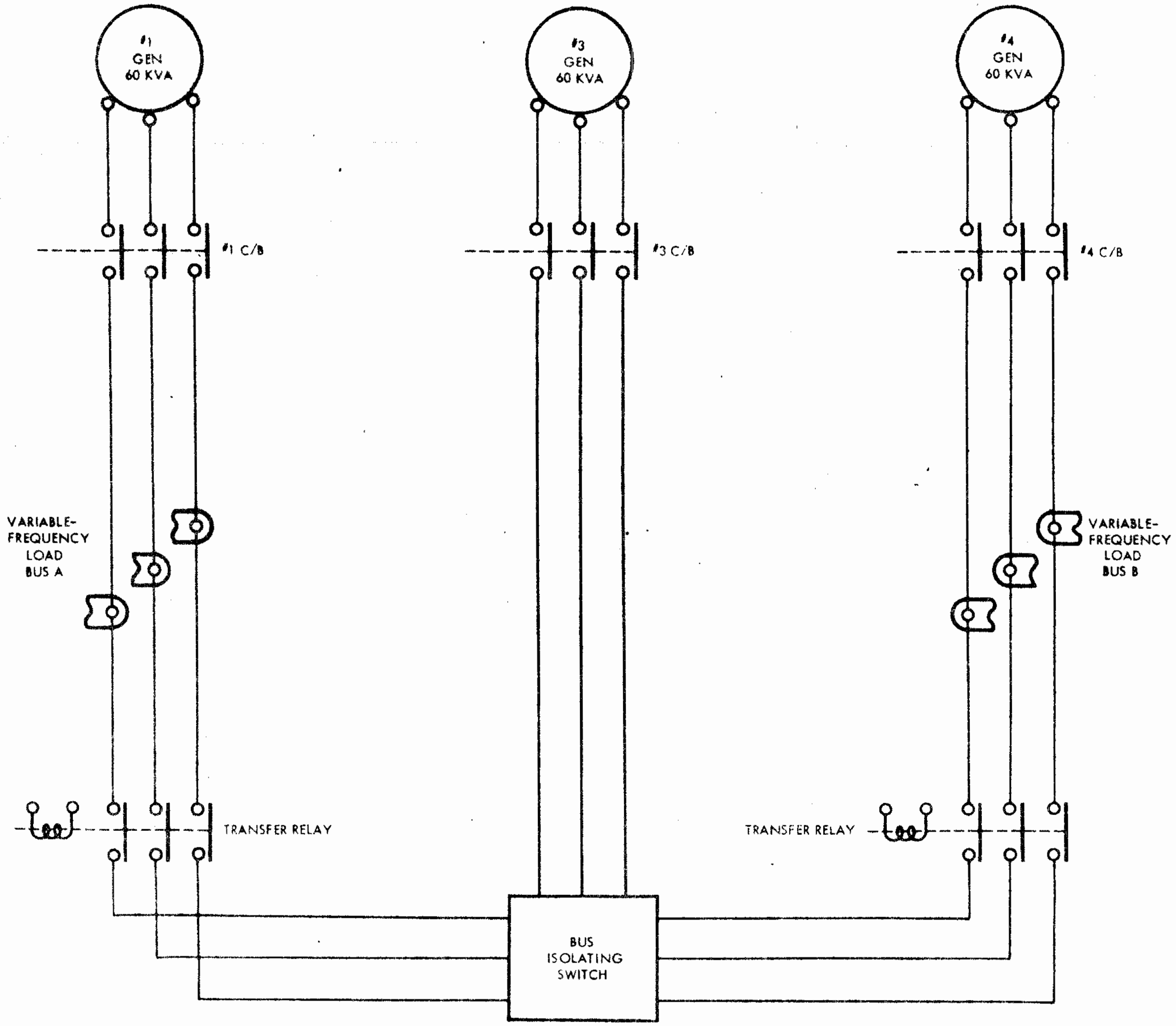
Control of ground power is by means of the GPU-OFF switch which, when placed to GPU, will energize the ground power relay and so permit ground power to feed the aircraft bus tie. The OFF position can be used to shut off a.c. ground power from the aircraft bus tie without disconnecting the ground power unit. An amber indicator light, adjacent to the GPU switch, will illuminate when the ground power circuit-breaker closes.

3. Variable-frequency A.C. System

The variable-frequency a.c. system is used to power the majority of the anti-icing services. The system is powered by three 60-kva generators driven through the auxiliary gear-boxes by engines No. 1, 3 and 4. Generators No. 1 and 4 feed load buses A and B respectively, generator No. 3 acting as a stand-by unit (Ref. Fig. 5). With the exception of there being no ground power connections, the basic schematic is similar to that of the constant-frequency system. If one or more generators fail, automatic and manual switching function in the same way as the constant-frequency system. However, on engine start-up and shut-down, the handling of the variable-frequency system differs from that of the constant-frequency system.

A. Variable-frequency A.C. Generators

Each variable-frequency a.c. generator is a 60-kva 3-phase 120/208-volt 320/480-cycle machine with a rated power factor of 0.90 lagging. Generator cooling is accomplished by ram air during flight and by integral fans while the aircraft is on the ground. The variable-frequency generators are similar in construction and operation to those of the constant-frequency system. Control of the d.c. exciter generator within the 60-kva generator



OPERATION

1. Normal - Generators 1 & 4 operating: # 3 stand-by.
2. Failure of either #1 or #4 generator automatically connects #3 generator to bus of faulty machine.
3. Failure of any two generators automatically connects the remaining generator to both load buses.
4. No provision for ground power supply.

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Variable-frequency A.C. Generating System
Figure 5

is by a carbon-pile type of voltage regulator.

B. Generator Circuit-breakers and Bus Tie Relays

The generator circuit-breakers and bus tie relays of the variable-frequency system operate in the same way as those of the constant-frequency system.

C. Generator Control Panels

The generator control panels are similar in construction and operation to those of the constant-frequency system except that the underspeed relay in each panel remains energized when d.c. power is on the aircraft. On engine shutdown, this condition causes the generator control relay to trip in addition to the tripping of the generator circuit-breaker. Therefore, on subsequent engine starts, the generator control switch must be momentarily placed to RESET to bring the generator onto the line. However, normal operating procedures demand that the variable-frequency generators be tripped off the line whenever engine speed is reduced below 67% LP rpm (refer to Section 2, Normal Operating Procedures).

D. Variable-frequency A.C. Control and Indicators

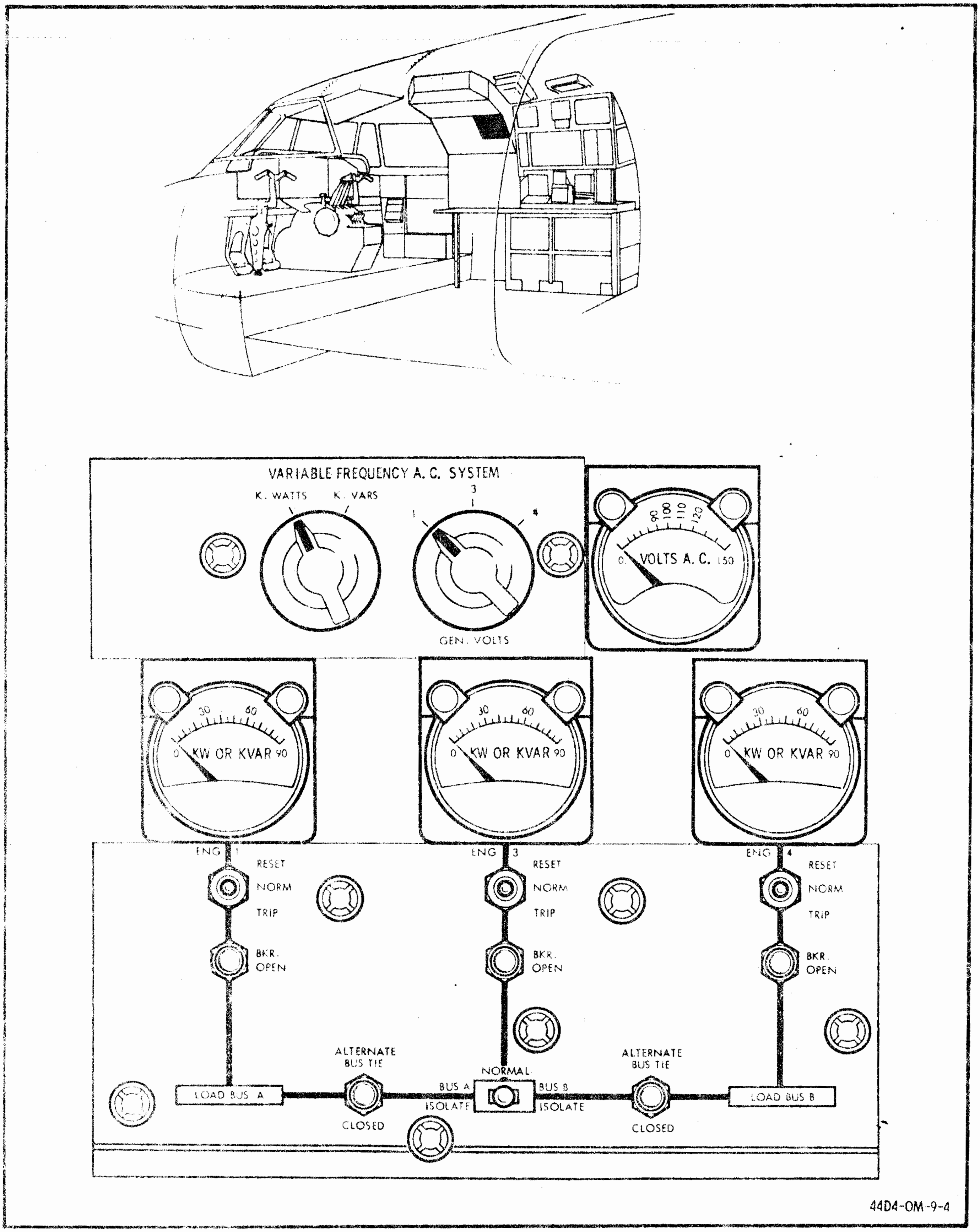
The controls and indicators for the variable-frequency a.c. system are located on the variable-frequency a.c. panel of the systems operators centre panel (Ref. Fig. 6).

The panel is engraved to represent the basic schematic of the system. The generator watt-varmeters, control switches, bus isolating switch, circuit-breaker and alternate bus tie indicator lights operate and indicate in the same way as those of the constant-frequency a.c. system. A voltmeter, used in conjunction with the adjacent generator selector switch, will indicate the voltage of each generator.

4. D.C. Power System

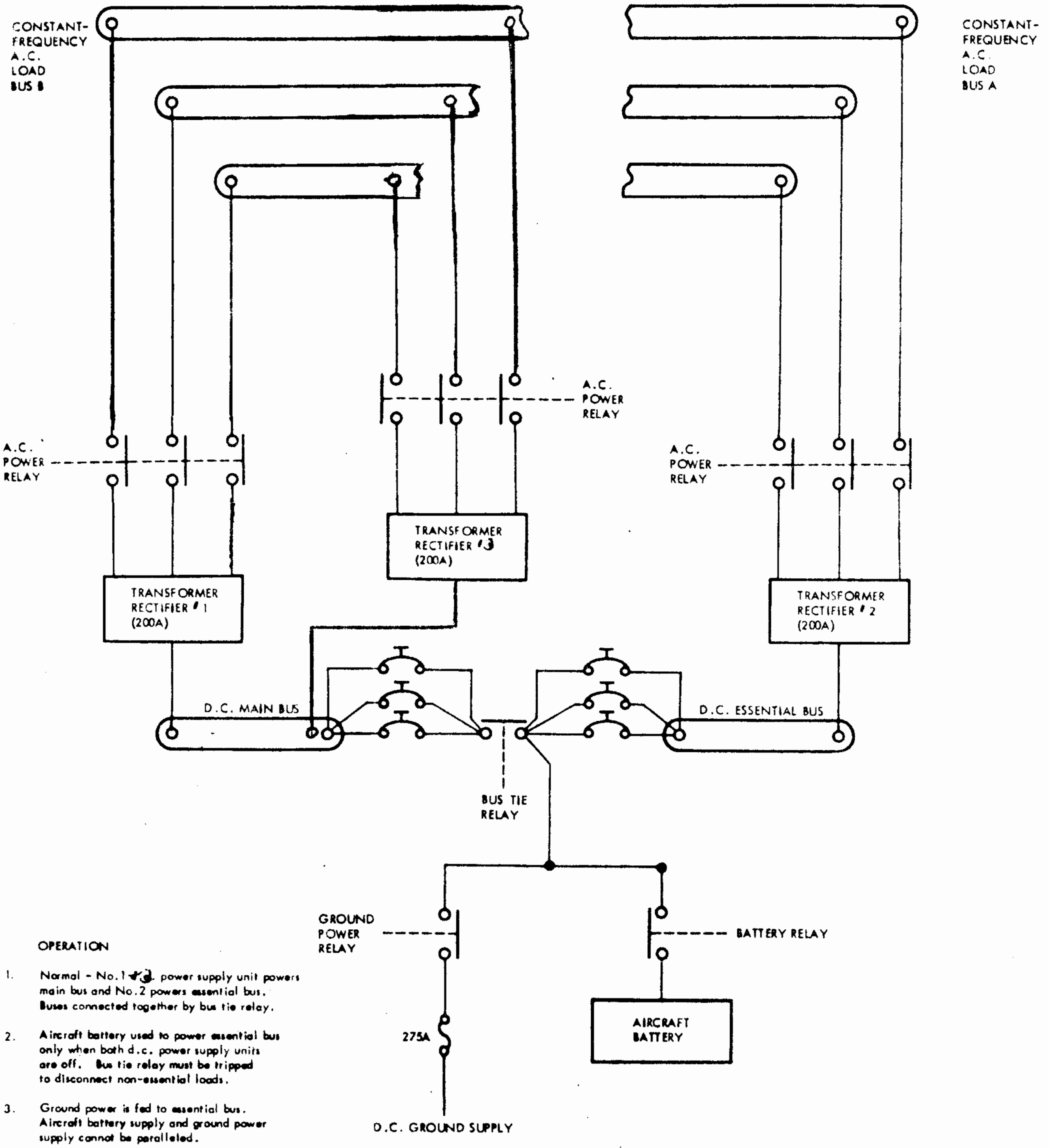
D.C. power for the aircraft may be obtained from the power supply units, the battery or an external ground power unit.

Normal d.c. power is provided by three power supply units powered by the constant-frequency a.c. system (Ref. Fig. 7) No.1&3 power units are fed by a.c. load bus B and supplies the main d.c. bus; No. 2 power unit is fed by a.c. load bus A and feeds the essential d.c. bus. Three-phase a.c. is connected to the power supply units by a.c. power relays which are controlled by the power supply master switches on the systems operators panel. Control power for the a.c. power relays is normally obtained from the a.c. control panels with a back up supply from the d.c. essential bus. The d.c. power for the a.c. power relays is available even when no battery power remains provided that



Variable-frequency A.C. System Controls - Systems Operators Station

Figure 6



OPERATION

1. Normal - No.1 &3 power supply unit powers main bus and No.2 powers essential bus. Buses connected together by bus tie relay.

2. Aircraft battery used to power essential bus only when both d.c. power supply units are off. Bus tie relay must be tripped to disconnect non-essential loads.

3. Ground power is fed to essential bus. Aircraft battery supply and ground power supply cannot be paralleled.

D.C. System
Figure 7

an a.c. generator is operating. The rectified d.c. output from each constant-frequency control and protection panel is connected in parallel and supplied through fuses as control power to each power supply master switch. The output of each power unit is fed through a reverse-current circuit-breaker before connecting to its respective bus.

The main d.c. and essential d.c. buses are connected by a main bus tie-in relay which is controlled by a switch on the systems operators panel. Control current for the relay coil can be supplied from either the main d.c. bus or the essential d.c. bus, or both. Diodes in the main bus tie-in relay control circuit prevent cross-feed between the two d.c. buses.

A. D.C. Power Supply Units

Each d.c. power supply unit is a transformer-rectifier unit. Three-phase a.c. power is fed to a three-phase transformer in each unit. The secondary windings of the three-phase transformer are connected to a full-wave bridge-type silicon rectifier. A variable-speed cooling fan automatically regulates airflow with altitude.

B. Reverse-current Circuit-breakers

A reverse-current circuit-breaker in the output circuit of each power unit will trip when the power unit or its output feeders are shorted to ground. When the reverse-current circuit-breaker operates, it breaks the d.c. control circuit to the corresponding a.c. power relay, disconnecting the three-phase a.c. input to the power unit. A reverse-current circuit-breaker is also provided in the battery/ground power circuitry.

C. Bus Fault Protection

Protection against a short-circuit to ground at either the main bus or the essential bus is provided by a bank of three circuit-breakers on each side of the main bus tie-in relay. Battery and ground power is connected between the main bus tie-in relay and the three protection circuit-breakers at the essential bus side.

If a fault occurs on a bus, the output of one power unit will flow to the fault through both banks of circuit-breakers. The output of the battery or the ground power unit however, will flow only through the bank of circuit-breakers on the faulted bus side. The circuit-breakers carrying the heavier load will trip, isolating the faulted bus. The power unit connected to the faulted bus will be removed from that bus by its a.c. input circuit-breakers tripping. The remaining power unit and the battery or ground power unit will remain connected to the unfaulted bus.

D. Battery and Battery Operation

One 24-volt battery is installed in the forward hold for emergency d.c. power requirements. The battery is a lead-acid type with a capacity of 36 ampere-hours.

The battery/ground power selector switch, when selected to BATT, energizes the battery tie-in relay. Battery power is then supplied, through the battery reverse-current circuit-breaker and the bus connecting circuitry, to the essential d.c. bus or via the main bus tie relay to the main d.c. bus. D.C. control power for the battery tie-in relay coil is supplied direct from the battery and battery/ground power selector switch applies the ground return.

During normal operation of the d.c. system, the battery is charged through the reverse-current circuit-breaker by the 28 volts on the aircraft bus. The reverse-current circuit-breaker protects against short circuits on the line from battery bus.

E. D.C. Ground Power

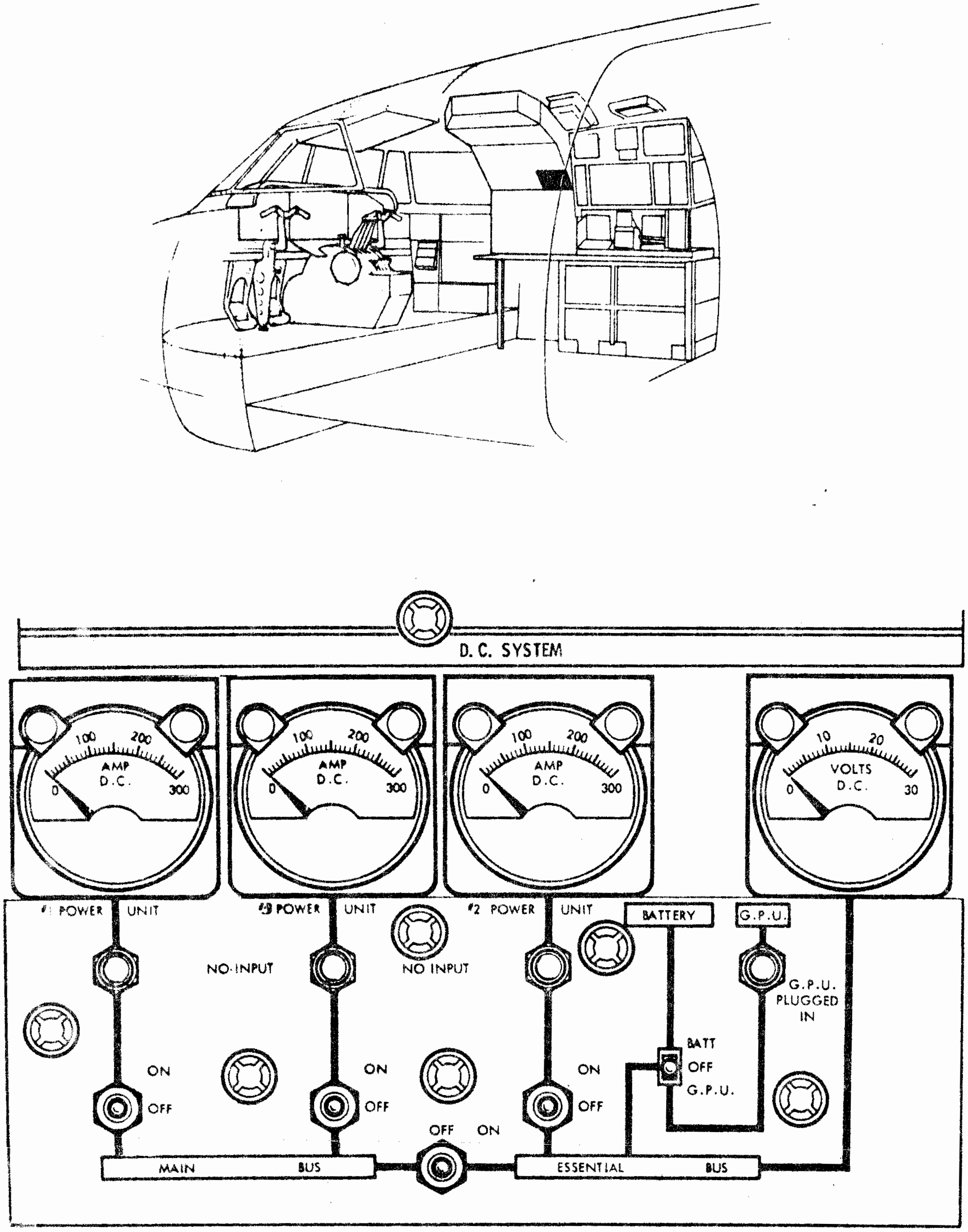
D.C. ground power is connected to the aircraft at the three d.c. pins in the external power receptacle. Two pins are used for the d.c. positive and negative connection. The third pin, which is shorter than the other two pins, connects d.c. positive to the control circuit of the d.c. ground power relay. A diode assembly is incorporated in the d.c. control circuit to prevent a ground power of wrong polarity from energizing the d.c. buses. A protection limiter of 275 amperes is installed between the positive pin in the external power receptable and the ground power relay contacts.

When correct polarity d.c. ground power is plugged into the external power receptacle, control power is fed to one side of the ground power relay coil. Selecting the battery/ground power selector switch to GPU completes the ground power relay energizing circuit and ground power is connected to the d.c. bus connecting feeders between the main bus tie-in relay and the bus protection circuit-breakers at the essential d.c. bus.

With this arrangement, ground power can be connected to either or both d.c. buses and circuit-breaker protection is provided should a bus be faulted. Ground power is fed from the ground power relay through the same feeders and reverse-current circuit-breaker that the battery uses.

F. D.C. System Controls and Indicators

The controls and indicators for the d.c. system are located on the d.c. control panel on the systems operators centre panel (Ref. Fig. 8).



D.C. System Controls - Systems Operators Station
Figure 8

The panel is engraved to represent the basic schematic of the system. Three ammeters are provided, each ammeter indicating the load imposed on its associated power unit. An amber NO INPUT light and a power unit master ON-OFF switch are mounted below each ammeter. Placing a power unit master switch to ON will allow 28-volt d.c. from the a.c. control panel to energize the related a.c. power relay and permit three-phase a.c. power to feed the associated power unit. The amber indicator light will illuminate when there is no input to the power unit.

A main bus tie-in switch is mounted between the two engraved bus panels. Selecting the switch on applies a ground to one side of the main bus tie-in relay coil.

Battery and ground power is controlled by the BATT-OFF-GPU switch. Placing the switch to BATT or GPU will energize the respective battery or ground power relay coils. An amber GPU PLUGGED IN light on the GPU schematic line will illuminate when correct polarity d.c. ground power is plugged into the external power receptacle. The voltmeter on the d.c. panel will indicate the voltage on the essential bus. By using the BATT-OFF-GPU switch, the power unit master switches and the main bus tie-in switch in conjunction with each other, the voltage of the battery, ground power or individual power units can be ascertained.

5. External Power Receptacle

The external power receptacle is located on the lower nose section, aft of the nose wheel well. The receptacle contains two sets of pins and is mounted behind a hinged panel that sits flush with the aircraft skin. The group of six pins is used for constant-frequency a.c. power and the set of three pins for d.c. power. A red warning light in the receptacle will illuminate if the constant-frequency a.c. ground power phase sequence is incorrect.

6. Electrical Load Distribution

All generated constant-frequency a.c. power, rectified d.c. power, a.c. and d.c. ground power and aircraft battery power is fed to load buses in the main distribution panel located behind the systems operator. Generated variable-frequency a.c. power is fed to load buses in the variable-frequency panel, located in the unpressurized interhold area. Electrical power is distributed from these two main distribution centres through appropriate circuit-breakers to points of utilization throughout the aircraft.

A. Constant-frequency A.C. Power Distribution

All constant-frequency circuit-breakers are contained on two panels on the main distribution panel, constant-frequency panels A and B. All circuit-breakers on panel A are powered from constant-frequency load bus A and those on panel B are powered from load bus B.

The following is a list of circuit-breakers on the two constant-frequency panels at the main distribution panel:

(1) Constant-frequency Circuit-breaker Panel A

CIRCUIT-BREAKER	Quantity
Flight Recorder (As required)	1
No. 1 Integrated Director System - VG and Attitude Channel	1
No. 1 Integrated Director System - Heading Channel	1
No. 1 Integrated Director System - Steering Computer	1
No. 1 Integrated Director System - Radio Instrument Power No. 1	1
No. 1 Compass System - Pilots RMI Servo Amp	1
No. 1 Compass System - Pilots RMI Ind	1
No. 1 Compass System - Remote Magnetic Compensator	1
No. 1 Compass System - Gyrosyn	3
Turn and Bank - Pilot	1
Auto Pilot	3
Turn and Bank - Co-pilot	1
No. 2 Compass System - Gyrosyn	3
No. 2 Compass System - Remote Magnetic Compensator	1
No. 2 Compass System - Co-pilots RMI Ind	1
No. 2 Compass System - Co-pilot RMI Servo Amp	1
No. 2 Compass System - Navigator RMI Ind	1
No. 2 Compass System - Navigator RMI Servo Amp	1
No. 2 Compass System - Radio Instrument Power No. 2	1
No. 2 Integrated Director System - Steering Computer	1
No. 2 Integrated Director System - Heading Channel	1
No. 2 Integrated Director System - No. 2 Vert Gyro (As required)	1
No. 2 Integrated Director System - No. 2 Vert Gyro and Attitude Channel (As required)	1
No. 2 Integrated Director System - Attitude Channel (As required)	1
Pilots Windshield - Windshield Wiper	3
Pilots Windshield - A/I Control - LH Main	1
Pilots Windshield - A/I Control - LH and RH DV	1
Pilots Windshield - A/I Power - LH Main	2
Pilots Windshield - A/I Power - LH DV	2
Pilots Windshield - A/I Power - RH DV	2
Tail A/I Cont - Hor Stab Deleted	1

CIRCUIT-BREAKER	Quantity
A/I Timer Standby	1
Pitot Tube Htr - Pilot	1
Turbine Gas Temp Nos 1, 2, 3 and 4	4
Wing Flap Motor Power RH	3
No. 2 D.C. Power Unit Supply	3
Ext. Lighting RH - Landing	1
Ext. Lighting RH - Taxi	1
Anti-skid Braking System	1
Prop Feather Pumps Nos 1 and 4	6
Deleted	
Fuel Booster Pumps Supply - Main No. 1 and Main No. 2	6
Fuel Booster Pumps Supply - Auxiliary No. 5 and No. 6	6
Engine Oil Pressure Indicators Nos 1, 2, 3 and 4	4
Torquemeters Nos 1, 2, 3 and 4	4
Hyd Pressure Indicators	1
Fuel Flowmeter Indicators Nos 1, 2, 3 and 4	4
Fuel Quantity System - Main Tanks Nos 1, 2, 3 and 4	4
Fuel Quantity System - Aux Tanks Nos 5, 6 and 7	3
Fuel Quantity System - Totalizer	1
Radio Power A	3
Instrument Bus Power - Pilots	3
Instrument Bus Power - Co-pilots	3
Swing Tail Hydraulic Pump (As required)	3
Galley Power (As required)	3
Pneumatic System Standby Pump 1 (As required)	3

(2) Constant-frequency Circuit-breaker Panel B

CIRCUIT-BREAKER	Quantity
Co-pilots Windshield - Windshield Wiper	3
Co-pilots Windshield - A/I Control - RH Main	1
Co-pilots Windshield - A/I Control - Front	1
Co-pilots Windshield - A/I Power - RH Main	2
Co-pilots Windshield - A/I Power - Front	2
Co-pilots Windshield - A/I Power - Demist	2
Elev Horn - Anti-ice Control LH	1
Elev Horn - Anti-ice Control RH	1
A/I Timer Main	1
Pitot Tube Heaters - Co-pilot	1
Pitot Tube Heaters - Artificial Feel LH and RH	2
Flt. Deck Temp Control	1
Air Cond Control	1

CIRCUIT-BREAKER	Quantity
Wing Anti-ice Controls - LH Inbd and Outbd	2
Wing Anti-ice Controls - RH Inbd and Outbd	2
Prop Feather Pumps Nos 2 and 3	6
Wing Flap Motor Power LH	3
Artificial Feel System	3
Wing spoiler LH and RH	6
Wing Spoiler Control	1
Pre-stall Warning Computer	1
Radio Power B	3
Radio Rack Cooling Fan	3
Pneumatic System Standby Pump 2 (As required)	3
Fuel Booster Pumps - Main Nos 3 and 4	6
Fuel Booster Pumps - Auxiliary Nos 6 and 7	6
No.1&3 D.C. Power Units	6
Instrument Bus Power - Pilots	3
Instrument Bus Power - Co-pilots	3
Ext Lighting LH - Landing	1
Ext Lighting LH - Taxi	1
Service and Razor Outlets	1
Dome Lighting	1
Baggage Hold	1
Deleted	
Deleted	
Deleted	
Rudder Jack Box Heater	1

B. Variable-frequency A.C. Power Distribution

The variable-frequency a.c. distribution system is similar to the constant-frequency distribution system with the exception of location of buses, relays and circuit-breaker panel. The complete variable-frequency distribution centre is located in the unpressurized interhold area and is accessible only from the exterior of the aircraft via an access panel in the underside of the fuselage. Variable-frequency power from the buses is supplied to anti-icing through circuit-breakers and protection limiters. All variable-frequency circuit-breakers are contained on panels which are secured to junction boxes No. 5A and No. 5B in the interhold area.

The following is a list of circuit-breakers on the variable-frequency panels:

CIRCUIT-BREAKER	Quantity
JUNCTION BOX NO. 5A	
No. 1 Nac Scoop	3
No. 2 Cowl Shed Mat	3
No. 2 Cowl Part Strip	3
No. 2 Nac Scoop	3
No. 3 Cowl Shed Mat	3
No. 3 Cowl Part Strip	3
LH Elev Horn	3
JUNCTION BOX NO. 5B	
No. 1 Cowl Shed Mat	3
No. 1 Cowl Part Strip	3
No. 3 Nac Scoop	3
No. 4 Cowl Shed Mat	3
No. 4 Cowl Part Strip	3
No. 4 Nac Scoop	3
RH Elev Horn	3
Fin Scoop	3
LIMITED PROTECTED	
JUNCTION BOX NO. 5A	
Propeller and Spinner De-Icing No. 2 and 3	6
JUNCTION BOX NO. 5B	
Propeller and Spinner De-Icing No. 1 and 4	6

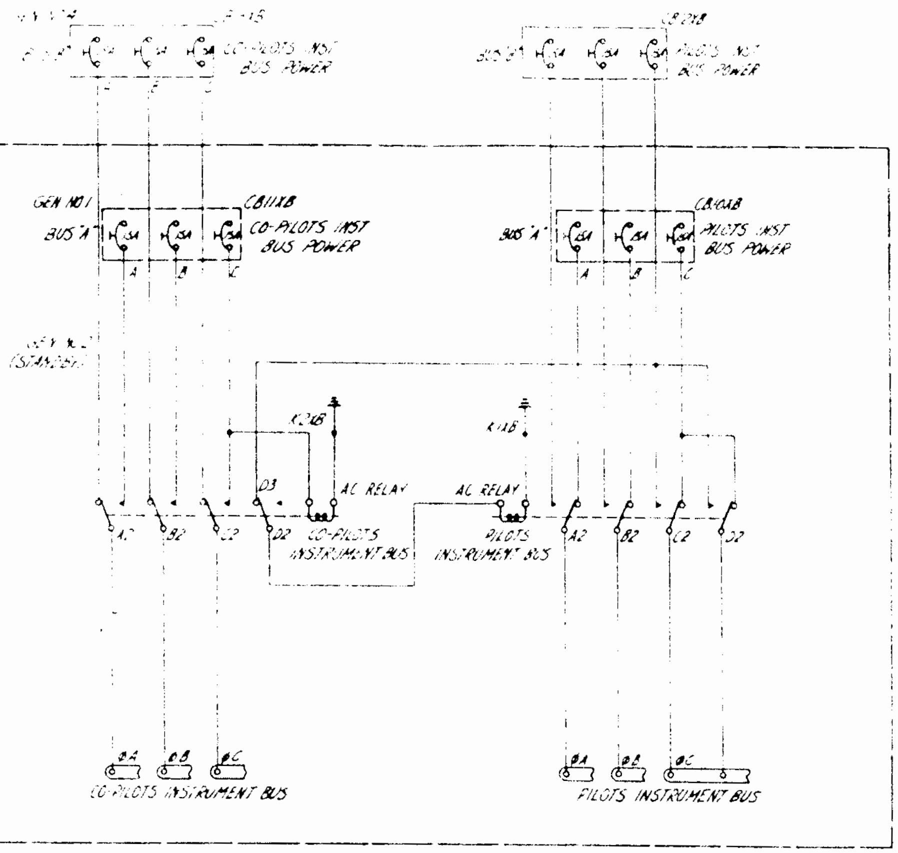
Instrument Bus Transfer

The instrument power distribution is so arranged that the three phase power supply to the pilots and co-pilots instrument buses is always synchronized for the two instrument systems. This power is normally supplied by bus A; in the event of a bus A failure it is supplied by bus B. The interchange of the pilots and co-pilots instrument buses between bus A and bus B is made by two relays K2XB and K1XB. (Ref. Fig. 1.)

Relay K2XB is energized from phase C of bus A and connects bus A to the co-pilots instrument bus. The pilots instrument bus is connected to bus A through contacts of K1XB energized. Should a failure of bus A occur, relay K2XB releases and connects bus B to the co-pilots bus. At the same time relay K1XB is operated from phase C of bus B through a contact of K2XB released; bus B is connected through K1XB contacts to the pilots instrument bus. The pilots and co-pilots instrument buses are now both supplied by bus B.

General Information

The pilots and co-pilots instrument buses are normally connected to constant-frequency bus A; the instrument buses automatically transfer to bus B should there be a bus A failure.



NOTE

1 DURING NORMAL OPERATION BUS "A" SUPPLIES THE PILOTS AND CO-PILOTS INSTRUMENT BUSSES. RELAY K2XB IS ENERGIZED AND RELAY K1BX IS DE-ENERGIZED

2 IF BUS "A" FAILS THEN BUS "B" SUPPLIES BOTH INSTRUMENT BUSSES. WITH THIS CONDITION RELAY K2XB IS DE-ENERGIZED AND RELAY K1XB ENERGIZED

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Instrument Bus Transfer - Electrical Schematic
Figure 1

C. D.C. Power Distribution

Direct-current power is distributed throughout the aircraft from the d.c. main and essential buses in the main distribution panel. The main d.c. bus is powered by the 28-volt rectified output from No. 1 power unit and the essential bus is powered by the output of No. 2 power unit. All d.c. circuit-breakers are contained on three circuit-breaker panels at the main distribution panel, d.c. main bus panel, essential bus panel A and essential bus panel B. Circuits between buses and operating equipment are single wire, with the aircraft structure used as a ground return.

The following is a list of the circuit-breakers on the three direct current panels on the main distribution panel:

(1) D.C. Main Bus Panel	Quantity
Deleted	
Rudder and Aileron Trim Off Load	1
Trim Tab Position Indicator - Rudder	1
Trim Tab Position Indicator - Aileron	1
Surface Position Indicators	1
Spoiler Warning Light and Overshoot Relay	1
Artificial Feel Pump Control	1
Wing Flap Normal Control - Main	1
Wing Flap Normal Control - Auxiliary LH and RH	2
Ignition Booster No. 2	1
Anti-skid Braking	1
Propeller Control - Pitch Lock Test	1
Deleted	
Deleted	
Propeller Control - Feather Pump Condition Lever Nos 1, 2, 3 and 4	4
Propeller Control - Engine Select Switch	1
Control Surface Lock Indicator	1
Gust Lock and Landing Gear Solenoid	1
Temp Indicators - Free Air - Pilot and Navigator	2
Temp Indicators - Skin Temp - Wing and Tail	2
De-ice Indicator Lights - Props	1
De-ice Indicator Lights - Cowl Shed Mats	1
De-ice Indicator Lights - Cowl Parting Strips	1
Oil Cooler Flaps Control Nos 1, 2, 3 and 4	4
Prop and Cowls De-icing Standby Control	4
Pre-check Valve Solenoid	1
Auxiliary Fuel Tanks - Manifold Shut-off Valves Nos 5-7	3
Primary Fuel System Master - Normal	1
Air Conditioning - Control - Master	1
Air Conditioning - Control - Flight Deck	1

	Quantity
Air Conditioning - Control - Ground	1
Air Conditioning - Valve Isolation	1
Air Conditioning - Temp Indicator	1
Wing A/I Air Conditioning Change Over Relay	1
De-ice Ready Indicator Lights Test	1
Props and Cowls De-icing Main Control Nos 1, 2, 3 and 4	4
Props and Cowl De-icing - Timer Sel Relay	1
Props and Cowls De-icing - Test	1
Engine Guide Vane Anti-icing Nos 1, 2, 3 and 4	4
Ice Protection Master Control	1
Deleted	
Galley Control (As required)	1
Windshield A/I Control - A/I Test and Demist	1
Windshield A/I Control - Front and RH Main	2
Elevator Horn A/I - Power Relay Control - LH and RH	2
Elevator Horn A/I - Indicator	1
Fin Scoop Anti-icing - Indicator	1
Fin Scoop Anti-icing - Control	1
Fin Scoop Anti-icing - Flap Indicator	1
Nacelle Scoop Anti-icing - Control Nos 1, 2, 3 and 4	4
Nacelle Scoop Anti-icing - Indicators Nos 1, 2, 3 and 4	4
Swing Tail - Hyd Pump Motor Control	1
Swing Tail - Control	1
Pneumatic System Standby Pump 1 (As required)	1
No. 2 Compass Amplifier	1
Wing Anti-icing - Mod Valve Emergency Close	1
Wing Anti-icing - Modulator and Spill Valves - LH inbd and outbd	2
Wing Anti-icing - Modulator and Spill Valves - RH inbd and outbd	2
Wing Anti-icing - Exhaust Flap Actuator LH and RH	2
Wing Anti-icing - Control LH and RH	2
Radio Power B	1
Inter Comm B	1
D.C. Main Bus-tie Alternate Supply	1
D.C. Bus Protection 4-5-6	3
Master Warning Power B	1
Systems Operators Panel Lights Test	1
A.C. Power Indicator Lights Test	1
Exterior Lighting - Anti-collision - Lower and Upper	2
Exterior Lighting - Landing Light Control LH	1
Exterior Lighting - Service Lights	1
Exterior Lighting - Loading Floodlights	1
Flight Deck Lighting - Crew Area Lighting	1
Flight Deck Lighting - F/E Panel	1

	Quantity
Flight Deck Lighting - Centre Inst Panel	1
Flight Deck Lighting - Overhead, Side Panels and Pedestal	1
Flight Deck Lighting - Sextant and Anti-dazzle	1
Flight Deck Lighting - Ind Lights Dim Relays	1
Flight Deck Lighting - Pilots i/c and Navigators Table	1

(2) D.C. Essential Bus Panel A

Ordinance Lights (As required)	1
Pneumatic System - Control and Low Press Warning (As required)	1
Pneumatic System - Control and Low Press. Warning (As required)	1
Pneumatic System Standby Pump 2 (As required)	1
Tow Warning and Nose Steer S/O Valve	1
Ground Safety Relays	1
Landing Gear Warning	1
Landing Gear - Actuator	1
Landing Gear - Indicator	1
Hydraulic System - Emerg Ldg Gear Sel Valve	1
Hydraulic System - Hnd Pump and Unload Valves	1
Hydraulic System - Freight Door Valves	1
Propeller Feathering Solenoid - ENG 1, 2, 3 and 4	4
Engine Fail and Beta Range Warning Lights - Engine 1, 2, 3 and 4	4
Engine Fail and Beta Range Warning Lights - Condition Lever	1
Engine Bleed Air Start (As required)	1
Engine Ignition and Start - Start	1
Engine Ignition and Start - Ignition Booster No. 1	1
No. 1 Compass Amplifier	1
Auto Pilot	1
Artificial Feel Low Pressure Warning	1
Pre-stall Warning	1
Anti-skid Braking Fail Indicator	1
Flight Recorder Warning (As required)	1
Wing Flap Position Indicator	1
Wing Flap Emergency Control - Main	1
Wing Flap Emergency Control - Selection Auxiliary LH and RH	2
Idling Throttle Valves Nos 1, 2, 3 and 4	4
Engine Gear Box Oil - Low Pressure Warning Nos 1, 2, 3 and 4	4
Deleted	
Deleted	
Cabin Smoke Control - Detector Light	1
Cabin Smoke Control - Cabin Air Valves Override	1

	Quantity
Empennage Fire Control - Detectors - Test	1
Deleted	
Empennage Fire Control - Detectors - Horizontal Stabilizer	1
Empennage Fire Control - Fire Extinguisher Discharge	1
Master Warning - Power A	1
Master Warning - Test	1
Engine Fire Control - Control Nos 1, 2, 3 and 4	4
Engine Fire Control - Services Nos 1, 2, 3 and 4	4
Engine Fire Control - Extinguishing Nos 1, 2, 3 and 4	4
Cabin Press - Diff Warning	1
Cabin Press - Altitude Warning	1
Door Open Warning	1
Flight Deck Lighting - Nav Lights	1
Flight Deck Lighting - F/E and MDP Utility	1
Flight Deck Lighting - Pilot and Navigators Utility	1
Flight Deck Lighting - Check List and Inst Flood	1
Landing Light Control RH	1
Engine Fire Detection - Fire and Overheat Test	1
Engine Fire Detection - Detection Nos 1, 2, 3 and 4	4
Engine Fire Detection - Tail Pipe Overheat Warning Nos 1, 2, 3 and 4	4
(3) D.C. Essential Bus Panel B	
A.C. Constant Frequency - Control Nos 1, 2 and 4	3
A.C. Constant Frequency - Ground Power Control	1
A.C. Constant Frequency - Alternate Bus Tie Ind Lights	1
D.C. Power Control - Voltmeter	1
D.C. Power Control - Failure Ind	1
D.C. Power Control - Main Bus Tie	1
Primary Fuel System Cont - Fuel Flowmeter Power Normal	1
Primary Fuel System Cont - Fuel Flowmeter Power Standby	1
Primary Fuel System Cont - Fuel Selector Valve Nos 1, 2, 3 and 4	4
Primary Fuel System Cont - Master Standby	1
Primary Fuel System Cont - Fuel Jettison System - Dump Valve Nos 1, 2, 3 and 4	4
Primary Fuel System Cont - Fuel Jettison System - Chute Act and Dump Valve Control LH and RH	2
A.C. Power Variable Freq - Control Nos 1, 3 and 4	3
A.C. Power Variable Freq - Alternate Bus Tie Ind Lights	1
D.C. Bus Protection 1-2-3	3
Radio Power A	1
Inter Comm A	1

	Quantity
Aux Fuel Tanks Control - S/O Valves and Booster Pumps Nos 5, 6, 7	3
Aux Fuel Tanks Control - Low Pressure Warning	1
Main Fuel Tanks - Manifold S/O Nos 1, 2, 3 and 4	4
Air Cond Supercharger - Control and Overheat Light LH and RH	2
Air Conditioning - Duct Temp Limiting	1
Empennage Anti-icing Control - Fuel S/O Valves Nos 1 and 2	2
Deleted	
Empennage Anti-icing Control - Horiz Stabilizer	1
Empennage Anti-icing Control - Ice Detect	1
Main Fuel Tanks Booster Pumps Nos 1, 2, 3 and 4	4
HP Turbine Oil Temp Ind	2
Engine Fuel Temp Warning Nos 1, 2, 3 and 4	4
Windshield A/I Control - LH and RH DV	1
Windshield A/I Control - LH Main	1
Wing Anti-ice Overheat Warning - LH Inbd and Outbd	2
Wing Anti-ice Overheat Warning - RH Indb and Outbd	2
Oil Inlet Temperature Indicator Nos 1, 2, 3 and 4	4
Low Oil Pressure Warning Nos 1, 2, 3 and 4	4
Fuel Low Pressure Warning Nos 1, 2, 3 and 4	4

7. Fuses

Fuses accessible in flight are located behind the top three circuit-breaker panels of the main distribution panel. The fuse link is visible through the glass and a blown fuse can be seen by inspection. Spare fuses are mounted adjacent to the fuse panel, and an additional spare fuse holder with spare fuses is located on the radio junction box cover, spare fuses are also stowed in the spare lamp stowage at the navigators station. In addition, one spare fuse is mounted on the fuse panel door on the aft face of the main distribution panel, which is accessible from the crew toilet. The rating of fuses is identified by coloured printing as follows:

Red	1/2 ampere
Yellow	1 ampere
Green	2 ampere
Blue	3 ampere

8. Power Outlets

An outlet for an electric razor is recessed in the crew toilet dome light frame. The outlet provides 115-volt d.c. power from a rectifier-converter which is supplied with 115-volt a.c. Six power outlets for servicing purposes are fed from the 115-volt constant-frequency a.c. bus and are controlled by the service lights master switch on the systems operators lighting control panel. The outlets are located in each wheel well, the forward and aft holds and in the unpressurized tail area. The tail outlet has an adjacent power indication light. The razor outlet and the six servicing power outlets are fed power through the service and razor outlets circuit-breaker on constant-frequency a.c. bus panel B. A 115-volt a.c. outlet, adjacent to the radio junction box, is provided for electronic equipment servicing.

9. Aircraft Lighting

The aircraft lighting system provides general and specific illumination for the aircraft interior and exterior. It is composed of lighting sub-systems in the following categories: flight compartment, cargo and service compartments, exterior and, on D4-1 and D4-2 aircraft, emergency. The lighting system does not include warning lights for individual systems. Power for the systems is supplied from the 115-volt a.c. constant-frequency bus, the 28-volt d.c. main bus and the 28-volt d.c. essential bus, except for the boarding lights and ditching lights which are supplied by battery.

A. Cockpit and Pilots Instrument Lighting

Rheostat controls, each with an integral off switch and located on the pilots overhead panel, control the lighting of the overhead panel, pedestal, side panels, pilots, co-pilots and centre instrument panels and the instrument floodlights. On D4-2 and D4-6 aircraft, red and white instrument floodlights are used and are controlled by the INST FLOOD rheostat. On D4-1 aircraft, the red instrument floodlights for the pilots, centre and co-pilots instrument panels are controlled by the PILOTS PANEL, CENTRE PANEL, and CO-PILOTS PANEL rheostats respectively. In addition, on D4-1 aircraft, white floodlights are installed adjacent to the red floodlights and are controlled by the INST FLOOD rheostat.

BRIGHT-OFF-DIM switches, also on the pilots overhead panel, control the stand-by compass light and the anti-dazzle lights. An indicators and warning lights DIM-BRIGHT switch, adjacent to the stand-by compass light switch, permits low or high intensity lighting on all indicators and warning lights for the cockpit and the systems operators panel. The pilots panel rheostat must be turned to the on position before the relays of the dimmer units can be energized, since the dimming circuit is wired through this rheostat. For an illustration of the cockpit and pilots instrument lighting controls on the pilots overhead panel, refer to Section 6.

Individually controlled utility lights and check list lights, each with an integral off switch, are provided for both the pilot and co-pilot. The utility lights, which have selectable red filters, can be detached from their mounts and used as hand lamps. In addition, a utility light mounting base is installed on the back of the pilots seat so that the main distribution panel utility light may be used to provide an alternative means of illuminating the overhead radio control panels.

B. Systems Operators Station Lighting

Edge-lit plastic panels provide control panel indirect white lighting at the systems operators station. Three rheostats on the systems operators lighting control panel, marked ANTI-ICE PANEL, ELECTRICAL PANEL, and FUEL MAN PANEL, control the lighting of the overhead, centre and lower panels respectively. A rheostat on the upper portion of the systems operators overhead panel controls the illumination of the adjacent check pilots intercom panels. Individually controlled utility lights with selectable red filters are provided at the systems operators station and on the main distribution panel.

C. Navigators Station Lighting

The panels and working area of the navigators station are illuminated by integrally-lit instruments, control panel indirect red lighting, an adjustable table lights and a utility light. The control panel, except the intercom panel, lighting and the instrument lights are together controlled by an off-bright rheostat marked PANEL LIGHTS. A similar rheostat, marked TABLE LIGHTS, controls the navigators table lights. Both rheostats are located on the navigators lighting control panel. The utility light is identical to those used at other crew stations.

D. Flight Compartment Dome Lights

Two dome lights, one on the flight compartment roof at the navigators station and one in the toilet, are individually controlled by their respective on-off switches on the navigators lighting control panel and the partition adjacent to the toilet door. Selection of the red and white lamps in both lights is controlled by a white-red switch, marked CREW DOME & TOILET LTS, on the systems operators lighting control panel.

E. Boarding Lights

Boarding lights are installed on the roof of the aircraft at the navigators station and adjacent to the forward cargo door. The lights are controlled by switches marked BOARDING LIGHTS on the systems operators lighting control panel and the electrical control panel above the cargo door. These switches permit on-off operation of the lights from either location.

F. Galley Light

The galley light shares a common canopy and lens with the forward cargo door boarding light. A switch, adjacent to the installation, permits operation of the galley light. Power for the light is supplied from the 28-volt d.c. bus through the crew area lighting circuit-breaker.

G. Cargo Compartment Dome Lights

Cargo compartment illumination is provided by 25 white dome lights installed on the cargo compartment roof. Two switches marked DOME LIGHTS are installed, one on the systems operators lighting control panel and one on the swing-tail control and lighting panel. These switches permit on-off operation of the dome lights from either location.

H. Hold Lights

The power supply to the 14 white lights in the forward hold and the 15 white lights in the aft hold is controlled by the systems operators service lights master on-off switch. Each hold lighting sub-system has switch control independent of the other. The aft hold lights sub-system has two switches, one marked BAGG HOLD LTS SWITCH mounted adjacent to the aft hold entrance and one marked AFT BAGGAGE COMP mounted on the swing tail and lighting control panel. These switches permit on-off operation of the aft hold lights from either location. The forward hold lights are controlled by an on-off switch adjacent to the forward hold entrance.

I. Loading Floodlights

Loading floodlights are installed at the base of the forward cargo door, and forward and aft of the fuselage swing-tail break. The forward cargo door floodlights are controlled by a switch marked LOADING LIGHT on the electrical panel above the forward cargo door. The rear fuselage floodlights are controlled by the switch marked LOADING LIGHTS on the swing tail control and lighting panel.

J. Service Lights

Service lights are located in each wheel well and in the inter-hold area. Power to the lights is controlled by a service lights master on-off switch on the systems operators lighting control panel. The wheel well lights are together controlled by two-way switches located one in the nose wheel well and one adjacent to the service lights master switch. The inter-hold area lights are controlled by a switch adjacent to the inter-hold area hatch.

9A. Deleted

B. Anti-collision Lights

Two flashing red anti-collision lights are mounted on the centre-line, one above and one below the fuselage. Each light has an on-off switch located on the pilots overhead panel.

C. Wing Floodlights

A 20-watt floodlight is installed in each outer nacelle to provide illumination of the outer wing leading edges. Both lights are controlled by a wing flood on-off switch on the pilots overhead panel.

D. Landing-Taxi Lights

The undersurface of each wing contains an extendible dual-filament landing-taxi light. Each light is controlled by a motor switch and a lamp switch, the four switches being located on the pilots centre instrument panel. The motor switch, which can be used as an inching switch, is marked EXTEND, OFF, and RETRACT; the lamp switch is marked TAXI, OFF, and LAND. Placing a motor switch to EXTEND will extend its associated light. Placing the light switch to LAND will energize both the 600-watt and the 400-watt filaments. Placing the light switch to TAXI will energize only the 400-watt filament. Each light is extinguished and restored to its housing by placing its light switch to OFF and its motor switch to RETRACT. A press-to-test amber warning light, mounted above each set of switches, will illuminate when the related landing-taxi light is in any position other than fully retracted.

11. Emergency Lighting

On the aircraft, two dinghy lights illuminating the trailing edges of the wings and two portable emergency lights are provided. For a description of these lights, refer to Section 21, Emergency Lighting.

12. Lighting Power Sources

The circuit-breakers and power sources for the aircraft lighting systems are as follows:

(1) Constant-frequency Bus Panel A	Quantity
Ext Lighting RH - Landing	1
Ext Lighting RH - Taxi	1

(2) Constant-frequency Bus Panel B	Quantity
Ext Lighting LH - Landing	1
Ext Lighting LH - Taxi	1
Dome Lighting	1
Baggage Hold	1
(3) D.C. Main Bus	
Exterior Lighting - Anti-collision - Lower	1
Exterior Lighting - Anti-collision - Upper	1
Exterior Lighting - Ldg Light Control LH	1
Exterior Lighting - Service Lights	1
Exterior Lighting - Loading Floodlights	1
Crew Area Lighting	1
Flight Deck Lighting - Systems Operators Panel	1
Flight Deck Lighting - Centre Inst Panel	1
Flight Deck Lighting - Overhead, Side Panels and Pedestal	1
Flight Deck Lighting - Sextant and Anti-dazzle	1
Flight Deck Lighting - Ind Lights Dim Relays	1
Flight Deck Lighting - Pilots i/c and Nav Table	1
(4) D.C. Essential Bus Panel A	
Flight Deck Lighting - Nav Lights	1
Flight Deck Lighting - Systems Operators and MDP Utility	1
Flight Deck Lighting - Pilot and Navigator Utility	1

	Quantity
Flight Deck Lighting - Check List and Inst Flood	1
Landing Light Control - RH	1

8. Master Warning System

The master warning system presents a centralized visual, and in some cases audible, indication to the pilots and the systems operator of warnings of engine malfunctions and conditions and certain aircraft system conditions. The conditions and malfunctions covered by the system are detailed below. Wording in parentheses denotes the actual wording on the annunciator panel (Ref. Fig. 9). The number 1, 2, 3 or 4 preceding the wording denotes the engine number.

(1) Low fuel pressure on each engine (FUEL PRESSURE)

(2) Low engine oil pressure on each engine (OIL PRESSURE)

(3) Tail pipe overheat on each engine (TAIL PIPE OVHT)

(4) Use of bleed air for engine guide vane anti-icing on each engine. (ENGINE BLEED)

(5) High fuel temperature on each engine (FUEL TEMP HIGH)

(6) Low fuel temperature on each engine (FUEL TEMP LOW)

(7) Engine failure on each engine (ENGINE FAIL)

(8) Accessory gear-box low oil pressure on each engine (ACC GR BOX)

(9) Failure of pitot heating (PITOT HEAT OFF L.H. & R.H.)

(10) Engine breather overheat on each engine (BREATHER O/HEAT)

(11) Overshooting of a spoiler (SPOILER O/SHOOT)

(12) Failure of wing flaps (WING FLAPS FAIL)

(13) Control surface locks engaged (SURFACE LOCK)

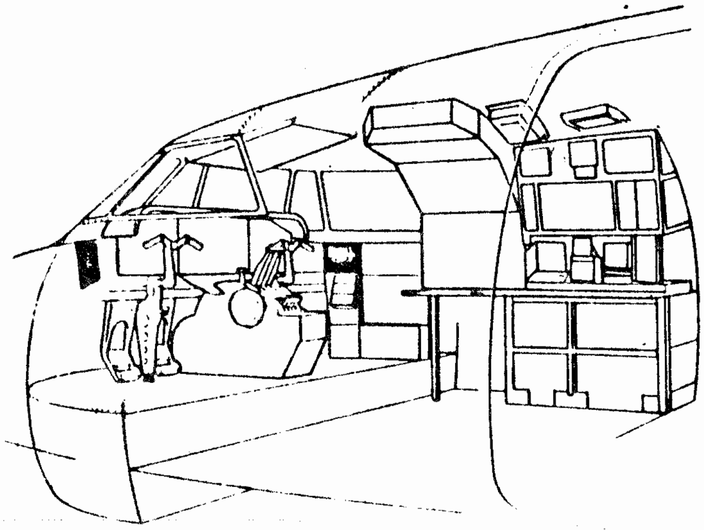
(14) Failure of the elevator artificial feel system (ELEV ART FEEL)

(15) Failure of the flight recorder (FLT REC FAIL) (As required)

(16) Swing tail not locked (SWING TAIL OPEN)

(17) Failure of the automatic flight control system (AUTO PILOT FAIL)

(18) Failure of the anti-skid system (ANTI-SKID BRAKES)



1 FUEL PRESSURE	2 FUEL PRESSURE	3 FUEL PRESSURE	4 FUEL PRESSURE
1 OIL PRESSURE	2 OIL PRESSURE	3 OIL PRESSURE	4 OIL PRESSURE
1 TAIL PIPE OVHT	2 TAIL PIPE OVHT	3 TAIL PIPE OVHT	4 TAIL PIPE OVHT
1 ENGINE BLEED	2 ENGINE BLEED	3 ENGINE BLEED	4 ENGINE BLEED
1 FUEL TEMP HIGH	2 FUEL TEMP HIGH	3 FUEL TEMP HIGH	4 FUEL TEMP HIGH
1 FUEL TEMP LOW	2 FUEL TEMP LOW	3 FUEL TEMP LOW	4 FUEL TEMP LOW
1 ENGINE FAIL	2 ENGINE FAIL	3 ENGINE FAIL	4 ENGINE FAIL
1 ACC GR BOX	2 ACC GR BOX	3 ACC GR BOX	4 ACC GR BOX
L.H.Pitot Heat OFF	R.H.Pitot Heat OFF		
1 BREATHER O/HEAT	2 BREATHER O/HEAT	3 BREATHER O/HEAT	4 BREATHER O/HEAT
SPOILER O/SHOOT	WING FLAPS FAIL		SURFACE LOCK
ELEV ART FEEL	FLT REC FAIL [1]		SWING TAIL OPEN
AUTO PILOT FAIL		ANTI SKID BRAKES	DOOR OPEN
ICE DETECTED		STAB HTR FIRE	CAB DIFF. PRESS.

LEGEND

☐ RED

☐ AMBER

[1] (As required)

Master Warning System - Annunciator Panel
Figure 9

(19) A door not locked (DOOR OPEN)

(20) Actuation of the ice detector system (ICE DETECTED)

(21) Horizontal stabilizer anti-icing heater fire (STAB HTR FIRE)

(22) Cabin differential pressure limit exceeded (CAB DIFF. PRESS.)

For the detailed conditions under which these warnings will be given, refer to the appropriate System Section in this manual.

The master warning system consists essentially of a master control box, two identical annunciator panels, warning lights of associated systems, three pairs of master lights and a test facility. Each pair of master lights consists of a red warning light and an amber caution light, a pair being located on the edge of the instrument shroud in front of each pilot and one pair in the center of the systems operators lower instrument panel. The annunciator panels are located outboard of each pilots flight instrument panel.

A. Master Control Box

The master control box is fed by all associated system and power plant warning circuits. When a warning circuit is energized, the signal will be passed through the master control box and so routed to cause illumination of the appropriate window on the annunciator panels and flashing of all the red or amber master lights. In the cases of No. 1, 2, 3 or 4 fuel low pressure, overheat of either empennage heater, cabin pressure differential exceeded, and ice detection, related warning lights on the systems operators panel will also illuminate.

B. Master Lights

The master lights will provide the pilots and systems operator with a simultaneous flashing indication of a malfunction or condition. A malfunction or condition which can affect the immediate safety of the aircraft is indicated by a continuous flashing of all red master warning lights. Flashing of the amber master caution lights denotes a non-critical condition. All the master lights are canceled and reset by depressing any one of the flashing lights. The system will then be ready for any further warnings. However, the illuminated annunciator window and any related light on the systems operators panel are not affected by the reset mode of the master lights and will continue to identify the sub-system at fault.

Warning of a fire condition will be given also by the continuous ringing of an alarm bell, located behind the co-pilot. The bell stops ringing when the master lights are reset.

C. System Test Switch

The system is tested by a master warning system test-normal switch on the pilots overhead panel. Placing the switch to TEST will energize the alarm bell, cause flashing of the master lights and illuminate all annunciator windows and related system warning lights. All warning lights and master lights may be dimmed by an indicators and warning lights dim-bright switch on the pilots overhead panel.

Stowage for spare lamps and a bulb extractor for the master lights is provided at the radio junction box in the flight compartment.

CA. Aircraft Grounding Points

Three points are provided on the airframe for attaching ground wires and eight receptacles are provided as refuelling grounds.

D. Power Sources

Power for the master warning system is supplied from the 28-volt d.c. main and essential buses at the main distribution panel, through the following circuit-breakers:

	Quantity
(1) D.C. Main Bus	
Master Warning Power B	1
(2) D.C. Essential Bus A	
Master Warning Power A	1
Master Warning Test	1

NO. 2 ENGINE A.C. INSTRUMENT POWER SUPPLY

Each aircraft has had an inverter installed to provide an alternate A.C. supply for No. 2 engine F/F, oil pressure and T.G.T. indication. This will permit starts when only D.C. ground power is available.

The inverter power control switch is located on the upper wall area directly aft of the Captain's seat.

Procedure

With only D.C. ground power available No. 2 inverter will be used as it is listed on the check list. That is, before starting the first engine, No. 2 engine.

No other engine will be started until after No. 2 engine constant frequency generator is on the line. When this is accomplished No. 2 inverter may then be switched off, and normal starting operation continued. The "Before Taxiing" check also provides an item to switch off No. 2 inverter in the event it has been used.

Caution As this inverter can be used successfully to start No. 2 engine with the required indication, one may be inclined to consider using the aircraft battery power for starting whenever only a ground air unit is available. This is not an acceptable practice, as normal D.C. amperage drains, including the inverter, may be as high as 50-60 amps. This will render the battery unserviceable after a period of 10 to 20 minutes. Normal D.C. power drain accounts for all but 10 amps. which is used by the inverter system.

GPU MONITORING PROCEDURE

Whenever the flight engineer is aboard an aircraft that has groundpower units plugged in, he will monitor the voltage output of the D.C. unit, and the frequency and voltage of the A.C. unit.

If the output of either GPU is not within the published limits, the F/E will turn off the control switch for the malfunctioning unit and take appropriate action to remedy the situation.

Caution **NEVER LEAVE AN AIRCRAFT UNTENDED WITH GROUND POWER ON.**

GROUND POWER PHASE SEQUENCE RELAYS

Ground power phase sequence relay failures have resulted in extensive delays. To avoid future extensive delays of this nature, an outline of the function of the relay, and a procedure to overcome the problem is given here.

The functions of the unit are to:

1. Prevent ground power supply to the aircraft bus, not of the proper phase sequence.
2. Prevent ground power supply to a static aircraft generator via a malfunctioning closed generator C.B.
3. Prevent paralleling of A.C. ground power supply with an aircraft generator supply.

In the event one is unsuccessful in obtaining power on the aircraft bus via the ground power circuit breaker, a procedure may be followed to duplicate the function of the phase sequence relay. With the initial checks accomplished the relay circuitry may be declared faulty and the operable ground power circuit breaker electrically closed by the outlined procedure. This would provide the necessary starting A.C. power. With the aircraft generating system available, the ground power C.B. may then be electrically opened.

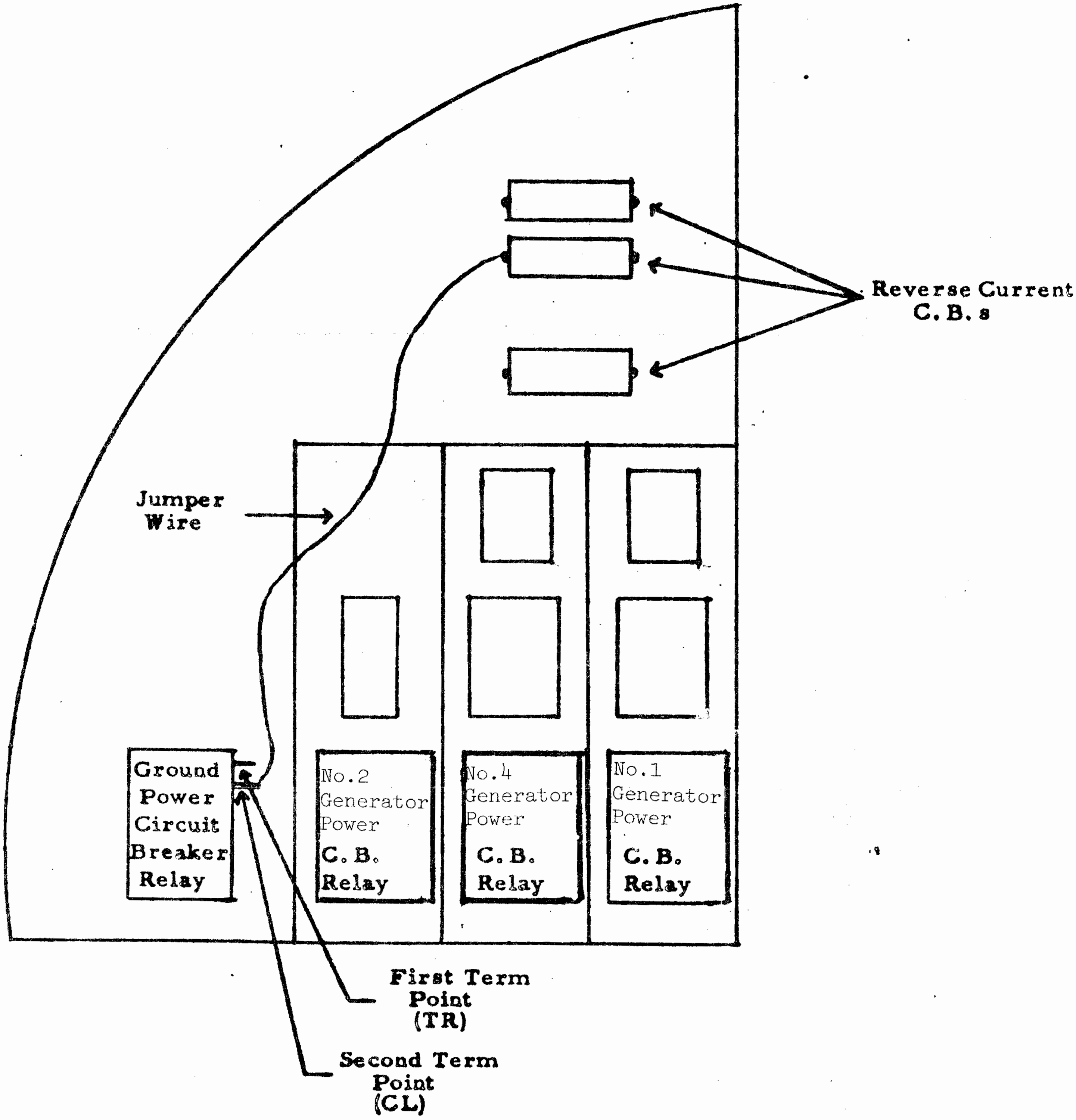
PROCEDURE TO INITIATE

By-Passing Faulty Phase Sequence Relay

1. Insure correct ground power supply and its connecting terminal phase sequence. (Each SWA station has a cart phase sequence tester.)
2. Trip No. 1, No. 2 and No. 4 constant frequency generator C.B.s and confirm such by amber indicating lights.
3. Pull 5 amps. ground power control C.B. 1A1/4. (To prevent phase sequence relay interference with ground power C.B. relay.)
4. With D.C. power on and ground A.C. power connected and readily available, electrically close ground power C.B. relay, accessible from the forward toilet area. This can be accomplished by completing the relay close circuit with a 30 inch jumper wire. Momentarily connect any D.C. supply terminal point of any reverse current C.B. with the second terminal point on the right of the ground power circuit breaker relay. The power C.B. relay will then remain latched in the closed position without further power supply. (See figure)
5. After engines are started and at ground idle, open the ground power C.B. relay, by momentarily connecting any D.C. supply terminal point of any reverse current C.B. with the first terminal point on the right of the ground power C.B. relay.
6. Reset 5 amp. ground power control C.B. 1A1/4 (resetting this C.B. may accomplish item 5, if it preceeds item 5, with no ill effect.)
7. Observe that A.C. ground power is off (G.P.U. amber light out).
8. Remove ground power supply.
9. Reset No. 2, No. 1 and No. 4 generator C.B.

CAUTION

Do not reset any generator C.B. until after the A.C. ground power has been removed to preclude paralleling of ground power and aircraft power supply


Reverse Current C.B.s
Jumper Wire
Ground Power Circuit Breaker Relay
No.2 Generator Power C.B. Relay
No.4 Generator Power C.B. Relay
No.1 Generator Power C.B. Relay
First Term Point (TR)
Second Term Point (CL)

AFT SIDE OF M.D.P.

SECTION 10

FIRE PROTECTION

1. Fire Detection

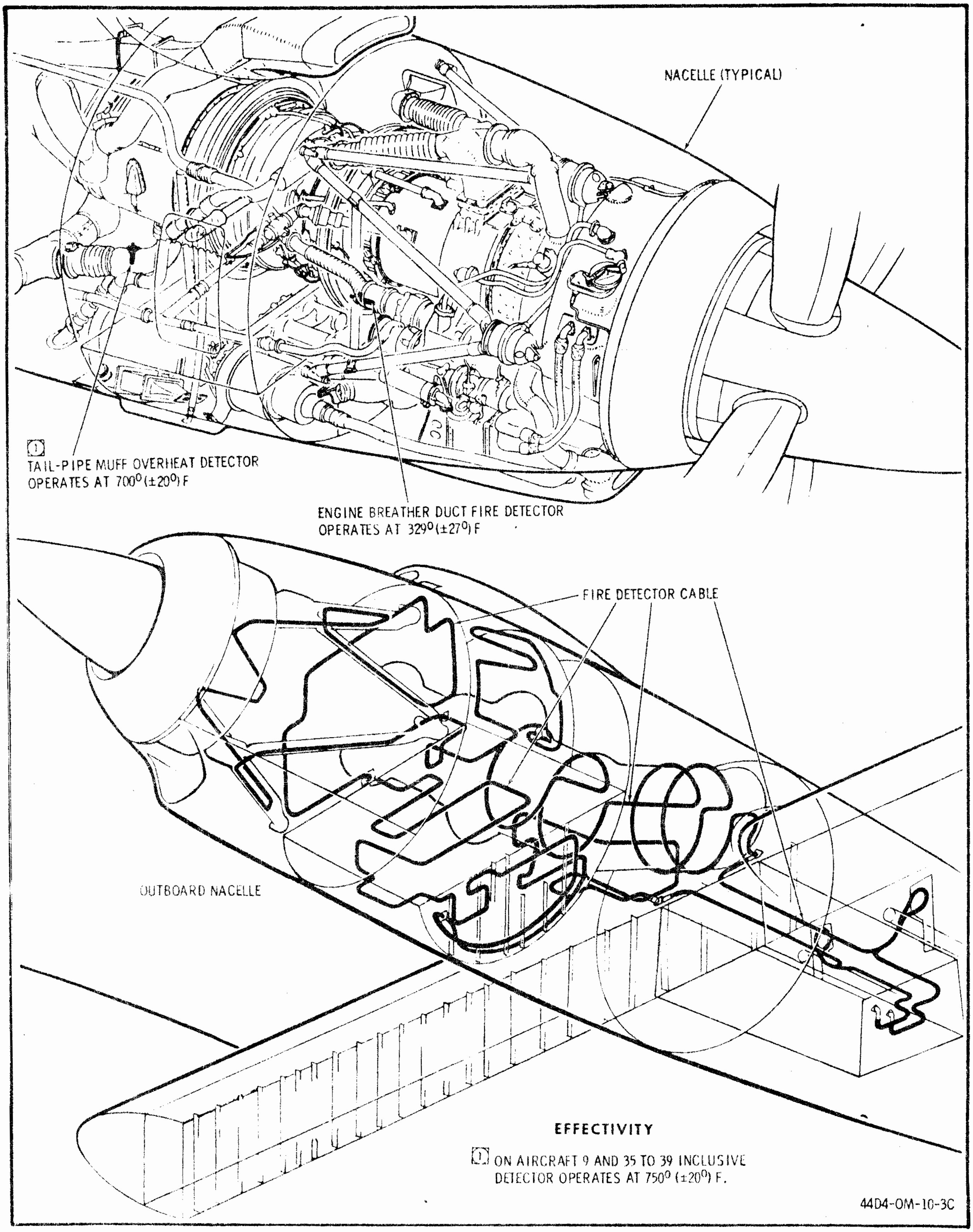
A. General

The fire protection system for the aircraft consists of fire detection and fire extinguishing sub-systems located in the various zones. In the zones where fire is most critical (the engines and empennage heater areas), automatic detectors, and manually selected electrically operated extinguishers are provided. Detection of fire in the main cabin area is provided by a smoke indicating system, which is not automatic. Upon selection, samples of air from the main cabin are inspected for smoke, and if any is indicated, air to the area is restricted and the fire extinguished through lack of ventilation. Hand-operated fire extinguishers are used to fight any fire that is accessible to the flight crew. The underfloor holds are classified as Class D compartments and no fire detection or extinguishing is provided.

B. Fire Detection Systems (Ref. Figs. 1 and 2)

Fire detection for the engines is provided by continuous-wire heat detectors running through each nacelle which, when subjected to abnormal heat, actuate the fire warning lights and bell in the flight compartment. The continuous-wire sensing element has a core material that decreases in resistance with increase in temperature, thus a low resistance exists between the inner and outer conductors when the wire is exposed to a high temperature, while at normal operating temperature the element presents a high resistance. The wire forms part of a bridge circuit connected to the master warning control, the pilots, co-pilots and systems operators master warning lights, the fire alarm bell, the appropriate engine condition lever light, and the fire indicator lights.

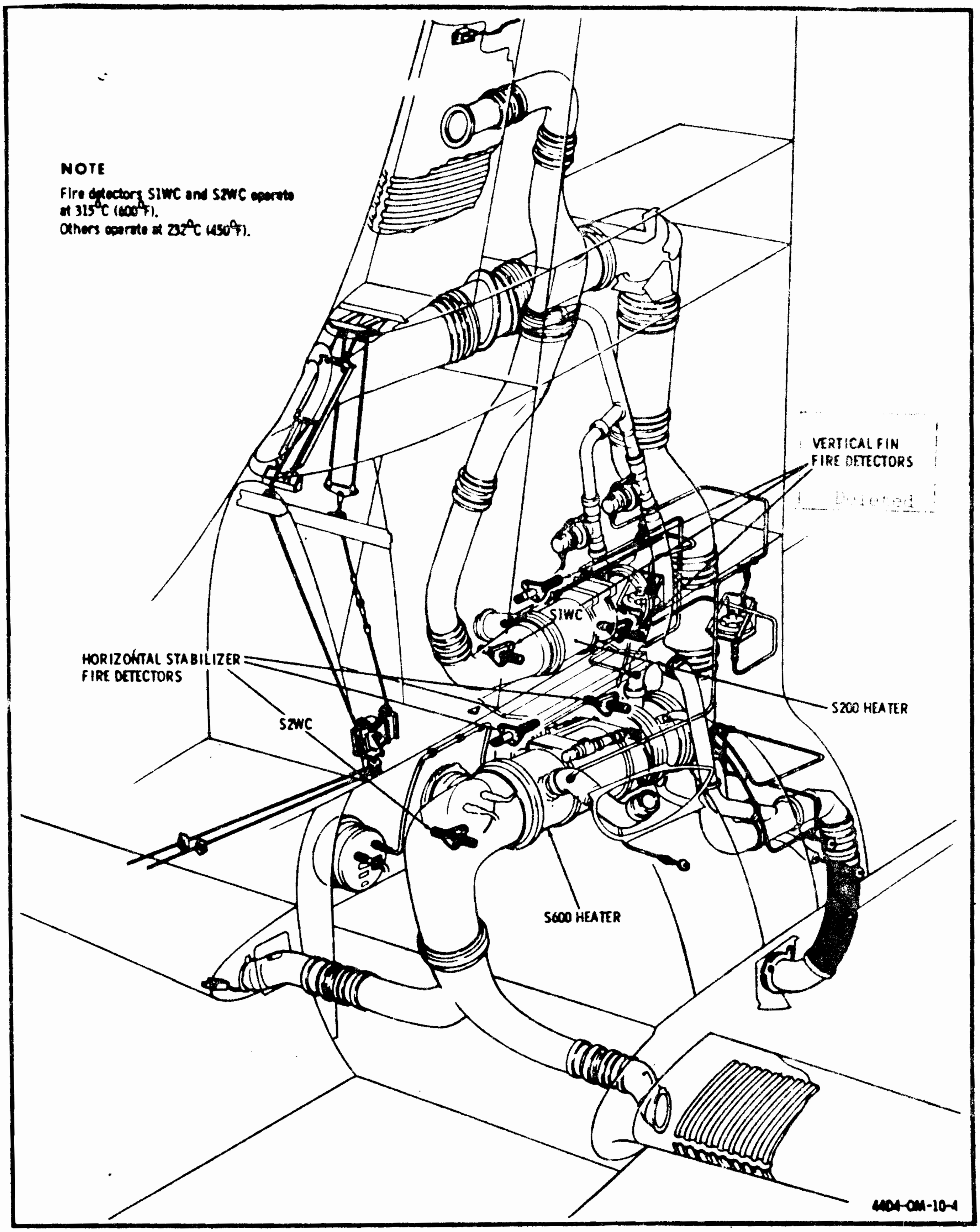
Two thermal switches are located on each power plant, one at the outlet duct of the tail pipe muff, and the other at the engine breather duct. Each is connected to the master warning system. Actuation of the tail pipe muff switch causes the master caution lights to flash and the annunciator panel windows marked TAIL PIPE O'HEAT to illuminate. Warning of an engine breather duct fire is provided by the flashing of the master warning lights and illumination of the annunciator panel windows marked BREATHER O'HEAT.


NACELLE (TYPICAL)
① TAIL-PIPE MUFF OVERHEAT DETECTOR OPERATES AT 700° (±20°) F
ENGINE BREATHER DUCT FIRE DETECTOR OPERATES AT 329° (±27°) F
FIRE DETECTOR CABLE
OUTBOARD NACELLE
44D4-OM-10-3C

EFFECTIVITY

① ON AIRCRAFT 9 AND 35 TO 39 INCLUSIVE DETECTOR OPERATES AT 750° (±20°) F.

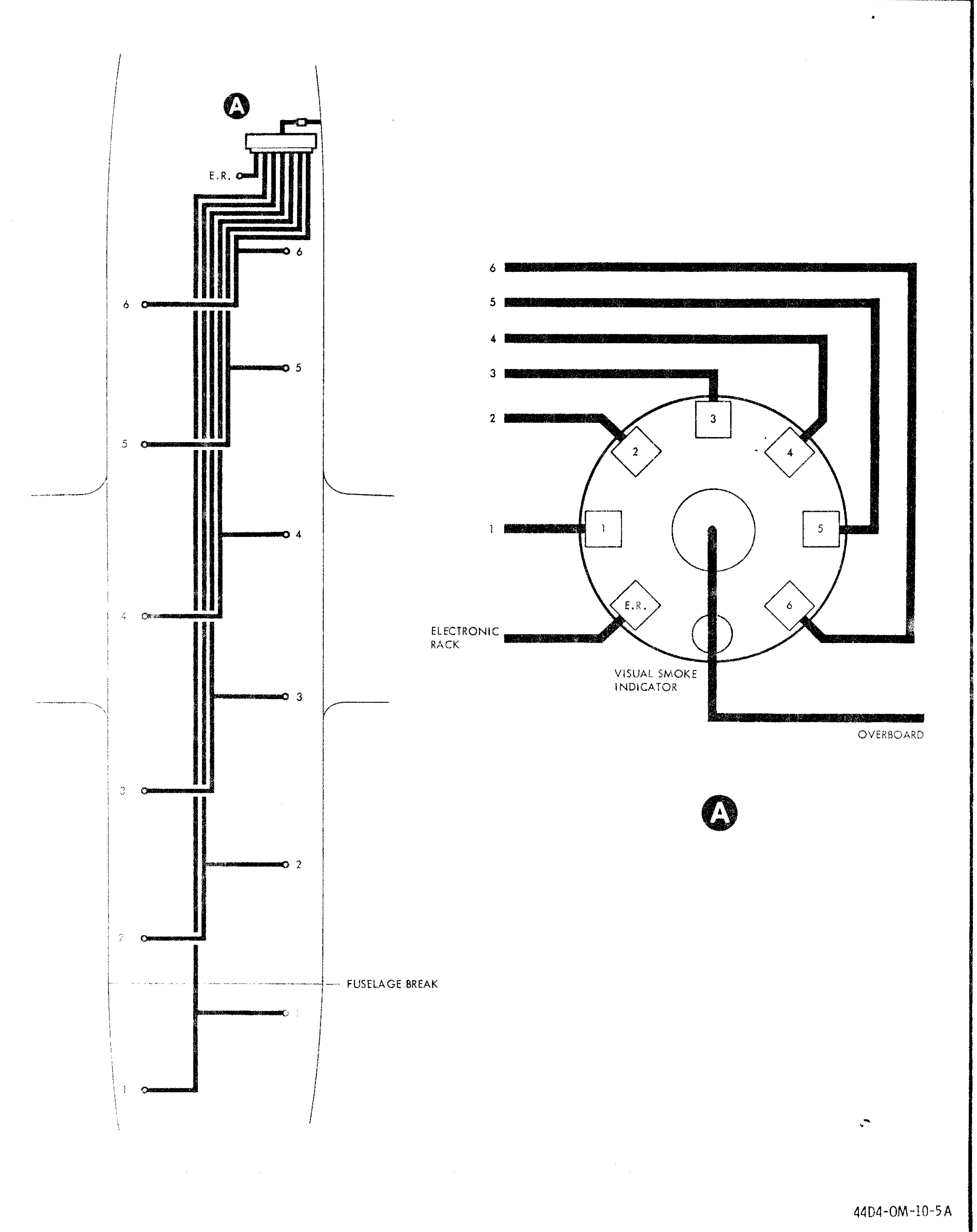
Engine Fire Detection System
Figure 1



NOTE

Fire detectors S1WC and S2WC operate at 315°C (600°F).
Others operate at 232°C (450°F).

Empennage Fire Detector
Figure 2



Smoke Indicating System
Figure 3

Fire detection for the empennage heater is provided by thermal switches installed in the area surrounding the heater. When subjected to abnormal heat, the switches close and complete the circuit to the warning system. Warning of a fire is provided through the master warning lights, the appropriate annunciator panel windows, the fire warning lights on the systems operators empennage fire control panel, and the fire warning bell. Actuation of the thermal switches will automatically shut off the fuel supply to the heater.

C. Smoke Indication System

A smoke indication system (ref. Fig. 3) is installed to indicate the presence of smoke in the main compartment or the electronic rack, Air from each of six areas of the main compartment and one from the electronic rack is routed through lines to the smoke indicator and then overboard through a vent. The indicator, located on the systems operators center panel, consists of seven windows, a shrouded bulb, a detect light and a push to detect button. When the button is depressed the shrouded bulb illuminates but is normally invisible in the windows, however, if any smoke is present the smoke particles will reflect the light and the appropriate window will appear to illuminate. The detect light is an indication that the shrouded bulb is serviceable. The air is continually routed through the indicator and only a momentary depression of the button is necessary to detect smoke.

D. Test Switches

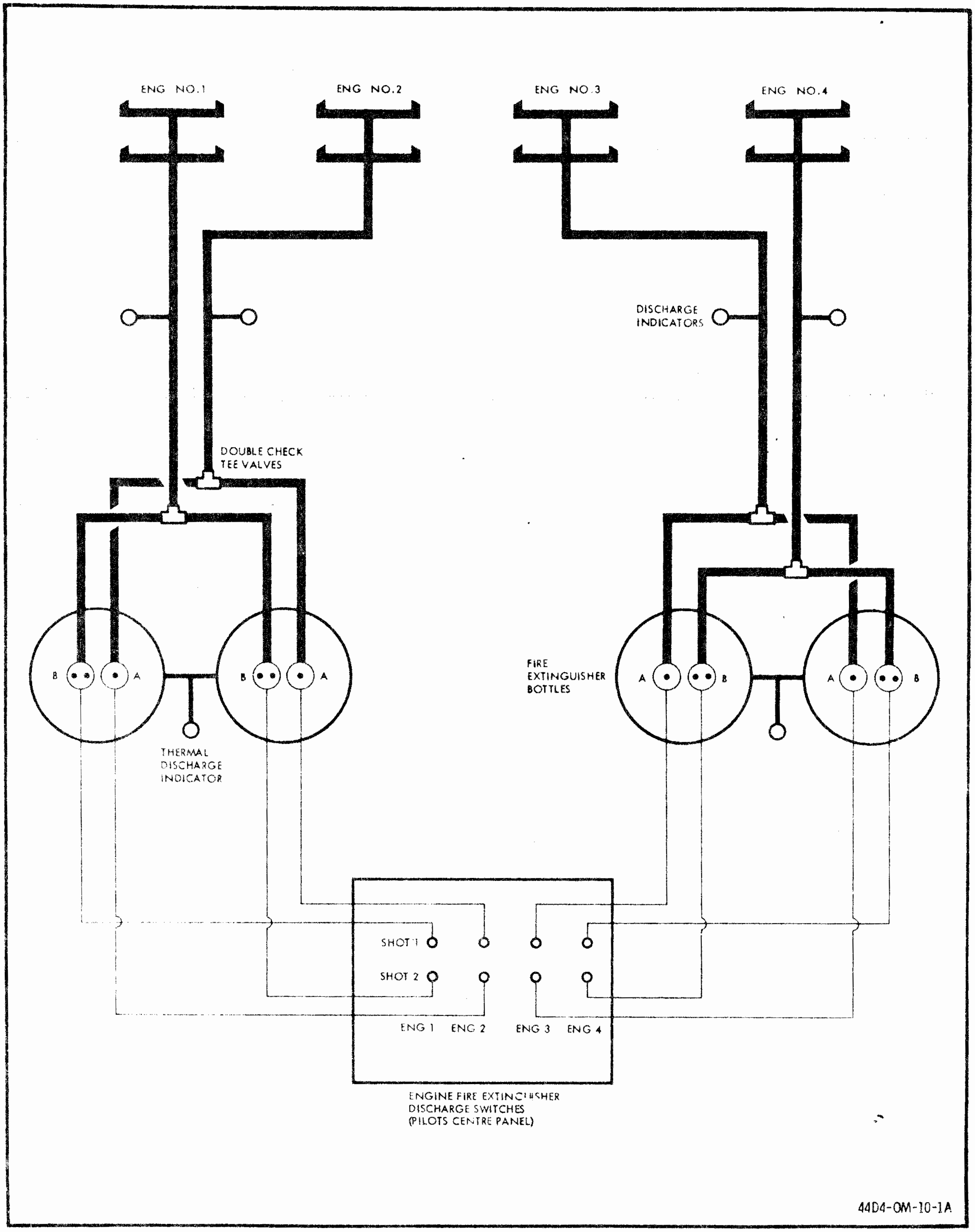
The engine fire detector circuits are tested by a switch, marked ENGINE FIRE AND TAIL PIPE OVERHEAT, on the pilots overhead panel. When the switch is moved to TEST, the warning circuits are energized and the master warning lights flash, the condition lever lights and the engine fire control panel warning lights illuminate. The light on the annunciator panel TAIL PIPE OVHT window will illuminate and the alarm bell will ring.

The empennage heater fire detector circuit is tested by a switch on the systems operators empennage fire control panel. The switch is marked ARMED, NORMAL, TEST. When moved to TEST, the warning light on the empennage fire control panel and the window on the annunciator panels, marked STAB HTR FIRE, illuminate. The master warning lights flash and the alarm bell will ring.

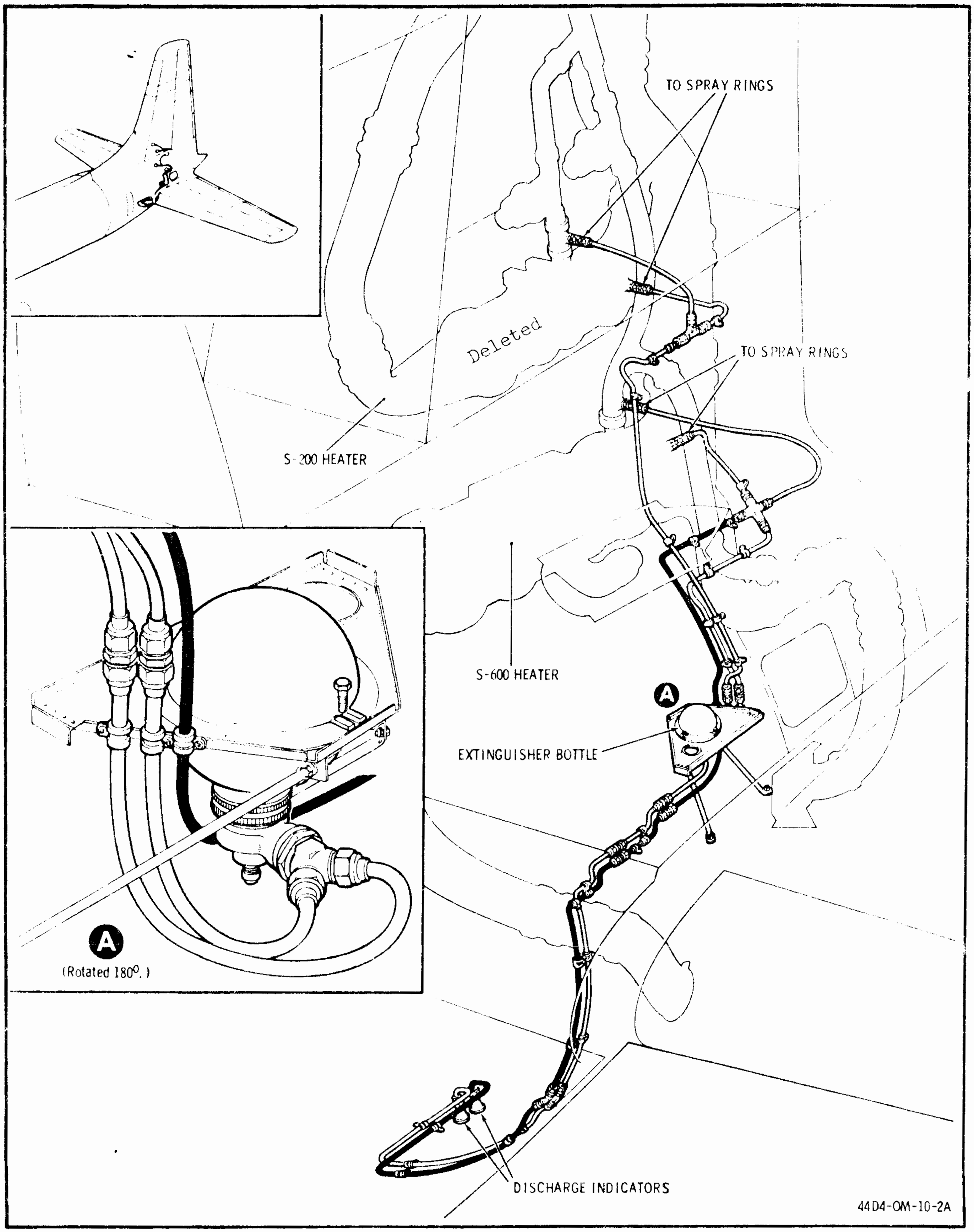
2. Fire Extinguishing Systems (Ref. Figs. 4 and 5)

A. General

Two fire extinguisher bottles are installed in each outboard nacelle and provide fire protection for both nacelles on each wing. Each bottle has two discharge bonnets and contains 15.5 pounds of Freon 13B1 pressurized with nitrogen to 625 psi at 70°F. The four discharge bonnets of the two



Engine Fire Extinguishing System - Schematic
Figure 4



Tail Heater Fire Extinguishing System
Figure 5

bottles on either side of the aircraft permit discharge of one shot to each nacelle or two successive shots to either, at the pilots discretion. The two bottles in nacelle No. 1 can only be discharged into either of the port nacelles, and the two bottles in nacelle No. 4 can only be discharged into the starboard nacelles. Thus, when both bottles on one side of the aircraft have been used, there is no further chemical fire protection available for that side. A yellow discharge indicator disc and a red thermal discharge indicator are mounted adjacent to the bottles on the skin of the outer nacelles. If either of these discs is damaged or missing, it indicates that the bottles are empty and must be replaced before flight. The system is armed by moving the condition lever of the affected engine to the FEATHER position and lifting it to arm the firex system.

The engine fire extinguisher discharge switches are located on the engine fire control panel on the pilots centre instrument panel. Each switch is guarded and is situated adjacent to the associated fire warning light. The switch is labelled SHOT 1 and SHOT 2. Moving the switch to the SHOT 1 position releases the contents of a bottle into the nacelle of the affected engine and if the fire warning does not cease within 30 seconds, moving the switch to SHOT 2 will release the second bottle to the same engine.

The empennage heaters are protected by a single bottle mounted in the vertical stabilizer. The bottle contains 4.5 pounds of Freon 13B1 and is pressurized with nitrogen to 400 psi at 70°F. The bottle has a single discharge head and discharges its contents into both heater areas. Controls for the system are provided at the systems operators empennage fire control panel. Discharge indicators similar to those on the engine fire control system are installed adjacent to the bottle.

Fires in the main cargo compartment are controlled by closing the cabin air valves and stopping the flow of air to the compartment. The valves are controlled by a guarded cabin air valves switch, marked CLOSED - NORMAL, on the cabin smoke control panel at the systems operators station. Moving the switch to CLOSED will close the valves in each of the cooled air delivery ducts to the compartment. Electronic rack fire is fought with the CO_2 hand fire extinguishers.

B. Portable Extinguishers

Two manually operated portable fire extinguishers are provided for the flight crew, one mounted in the crew compartment immediately behind the pilots seat and the other adjacent to the crew entrance door. Both are charged with CO_2 and are equipped with a lead sealed safety wire, which must be broken to permit operation of the unit. A broken wire indicates that the extinguisher may have been used.

C. Ground Fire Extinguishing

The cowling for each engine is equipped with two push-in panels, one on each side. In case of fire on the ground the panel is to be pushed in by the nozzle of the ground fire extinguisher and its charge released.

7. Power Sources

The circuit-breakers and power source for the fire protection systems are as follows:

(1) D.C. Essential Bus A	Quantity
Cabin Smoke Control - Detector Light	1
Cabin Smoke Control - Cabin Air Valves O'ride	1
Empennage Fire Control Detectors - Test	1
Empennage Fire Control Detectors - Vertical Fin	1
Empennage Fire Control Detectors - Horizontal Stabilizer	1
Empennage Fire Control - Fire Extinguisher Discharge	1
Engine Fire Control - Control 1, 2, 3, 4	4
Engine Fire Control - Services 1, 2, 3, 4	4
Engine Fire Control - Extinguishing 1, 2, 3, 4	4
Engine Fire Detection - Fire and Overheat Test	1
Engine Fire Detection - Detection 1, 2, 3, 4	4
Engine Fire Detection - Tailpipe Overheat Warning 1, 2, 3, 4	4

SECTION 11

FLIGHT CONTROLS

1. General

The flight control system consists of four primary and four secondary control systems. The primary controls are the ailerons, rudder, elevators and spoilers and the secondary controls are the flaps and the trim system for each set of main control surfaces (Ref. Fig. 1).

The ailerons, rudder and elevators are free floating, there being no direct linkage between the cockpit controls and the control surfaces. Movement of the conventional interconnected dual cockpit controls is transmitted by mechanical linkage to servo tabs at the trailing edge of each control surface. The aerodynamic reaction to the movement of the servo tabs operate the control surfaces. Due to this design, feedback of air loads is small and, in consequence, artificial feel systems are installed to simulate the forces which the pilot would normally expect to feel on the controls. Elevator artificial feel, which varies with control column displacement and airspeed, is supplied by a self-contained hydraulic system. Aileron and rudder feel loads are supplied by spring pots mounted in the linkage of the aileron and rudder primary control systems. A spoiler is installed on the upper surface of each wing to effectively increase the rate of roll in the lower speed range.

Aileron and rudder trim is effected by electric actuators which bias the neutral point of the artificial feel spring pots and thus reposition the servo tabs via the normal control system. Elevator trim is effected by direct mechanical linkage from the cockpit trim wheels to the inboard tab of each elevator. Each wing incorporates two electrically operated double-slotted Fowler-type flaps that are controlled from the pilots pedestal. A control surface lock system, operated from the main hydraulic system, is provided to prevent damage to the control surfaces when the aircraft is on the ground. An electrically operated prestall warning unit will impart an artificial vibration to the control column at speeds approaching the stall.

2. Aileron Control System (Ref. Fig. 2)

Movement of the pilots control wheel is transmitted by control rods and levers to a bevel gear-box on the aileron control unit beneath the cockpit floor. The bevel gear-box converts the linear motion of the rods into rotary motion which is transmitted by torque tubes to a three-way mitre gear-box attached to the rear spar in the fuselage. The output of the mitre gear-box is conveyed by torque tubes to variable-ratio screw-jacks mounted in the wing at the inboard end of each aileron. The screw-jacks reconvert the torque tube rotary motion to linear motion and operate the four outboard servo tabs by means of control rods and bell-crank levers in the aileron leading edge. The screw-jacks give relatively coarse movement towards the limits of travel and finer movement near the neutral position.

The inboard tab on each aileron is interconnected with the rudder control system and is not operated by the aileron controls. For operation of the aileron/rudder interconnect tab, refer to Paragraph 3., following.

A. Aileron Control Unit

The aileron control unit consists of a casting on which are mounted the bevel gear-box and lever assembly, the artificial feel spring pot, the trim actuator, trim transmitter, and auto pilot servo motor. The unit is one of three similar units mounted adjacent to each other which form the forward terminal points for the control runs throughout the aircraft, and which receive the mechanical operating forces from the pilots controls. The control units thus provide a centralized point for the integration of artificial feel, auto pilot and, on the aileron and rudder control units, trimming bias functions. The elevator control unit does not mount a trim actuator and trim transmitter.

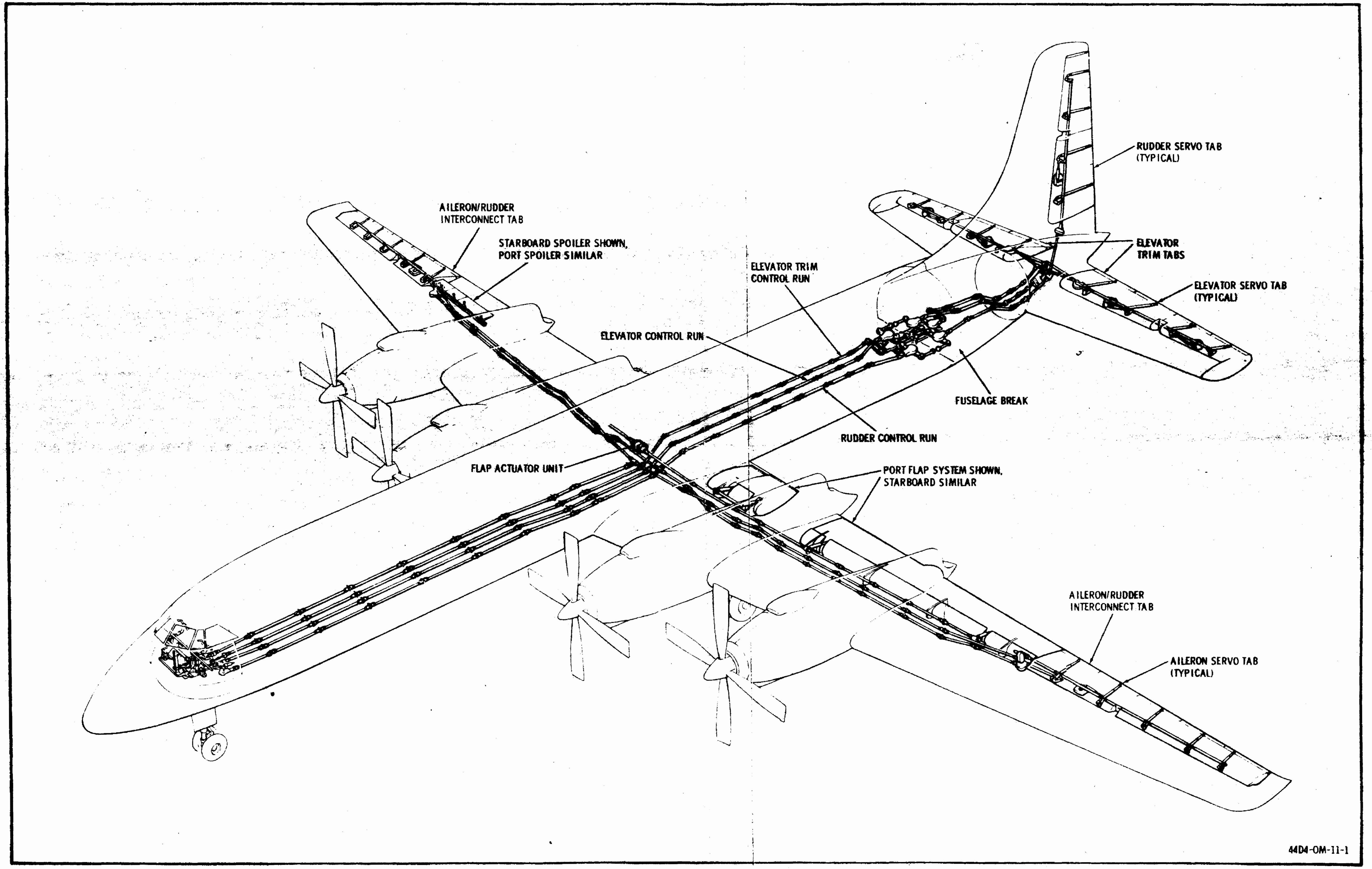
B. Anti-float and Anti-flutter Controls

Because the control surfaces are free floating, a torsion-type anti-float spring is installed within the aileron inner section to counteract the tendency of the surface to upfloat during flight. The assembly consists of an inner torsion bar which is housed within and is splined to an outer torque tube, the whole assembly being located in the aileron leading edge.

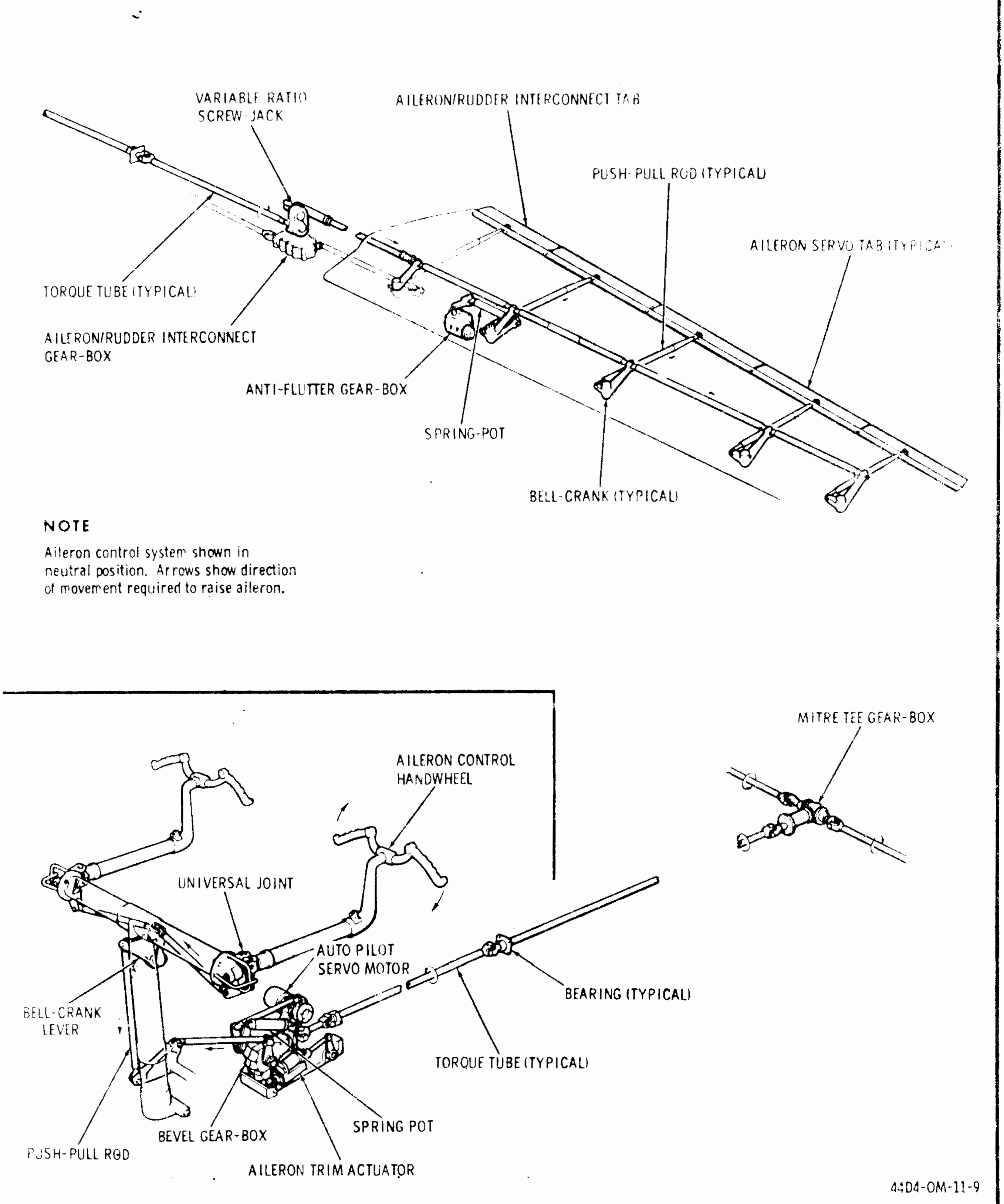
An anti-flutter gear-box is mounted within each aileron to prevent flutter of the servo tabs. The gear-box is attached to the aileron structure and a lever on the gear-box is connected by a spring pot to a bell-crank lever in the servo tab controls. Movement of the controls is transmitted through the spring pot to the input lever of the gear-box. The movement of the input lever will rotate a gear-box flywheel through the gear mechanism, the combined effect of the spring pot and the inertia of the flywheel damping out any flutter of the tabs.

C. Aileron and Aileron Servo Tab Travel

Aileron travel is 21° up and 15° down against the resilient stops, the stops being fitted to absorb the shock of contact with the wing structure at the extreme limits of aileron travel. The four outboard tabs travel 23°


RUDDER SERVO TAB (TYPICAL)
AILERON/RUDDER INTERCONNECT TAB
STARBOARD SPOILER SHOWN, PORT SPOILER SIMILAR
ELEVATOR TRIM CONTROL RUN
ELEVATOR TRIM TABS
ELEVATOR SERVO TAB (TYPICAL)
ELEVATOR CONTROL RUN
FUSELAGE BREAK
RUDDER CONTROL RUN
FLAP ACTUATOR UNIT
PORT FLAP SYSTEM SHOWN, STARBOARD SIMILAR
AILERON/RUDDER INTERCONNECT TAB
AILERON SERVO TAB (TYPICAL)
44D4-OM-11-1

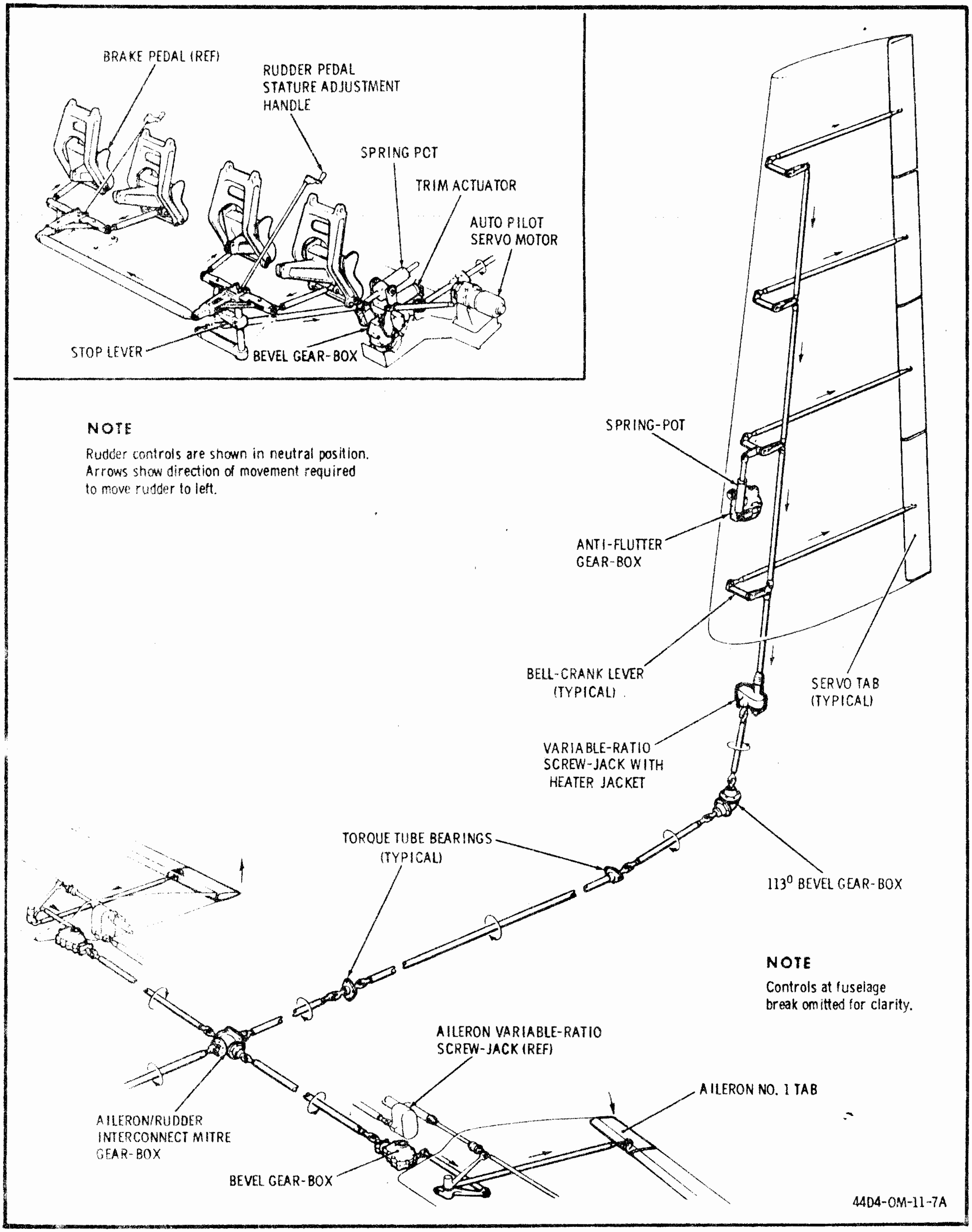
Flight Controls - General Arrangement
Figure 1



NOTE

Aileron control system shown in neutral position. Arrows show direction of movement required to raise aileron.

Aileron Control System
Figure 2


BRAKE PEDAL (REF)
RUDDER PEDAL STATURE ADJUSTMENT HANDLE
SPRING POT
TRIM ACTUATOR
AUTO PILOT SERVO MOTOR
STOP LEVER
BEVEL GEAR-BOX
SPRING-POT
ANTI-FLUTTER GEAR-BOX
BELL-CRANK LEVER (TYPICAL)
SERVO TAB (TYPICAL)
VARIABLE-RATIO SCREW-JACK WITH HEATER JACKET
TORQUE TUBE BEARINGS (TYPICAL)
113° BEVEL GEAR-BOX
AILERON VARIABLE-RATIO SCREW-JACK (REF)
AILERON NO. 1 TAB
AILERON/RUDDER INTERCONNECT MITRE GEAR-BOX
BEVEL GEAR-BOX
44D4-OM-11-7A

NOTE

Rudder controls are shown in neutral position. Arrows show direction of movement required to move rudder to left.

NOTE

Controls at fuselage break omitted for clarity.

Rudder Control System
Figure 3

up and 23° down. The aileron/rudder interconnect tab travels 20° up and 20° down.

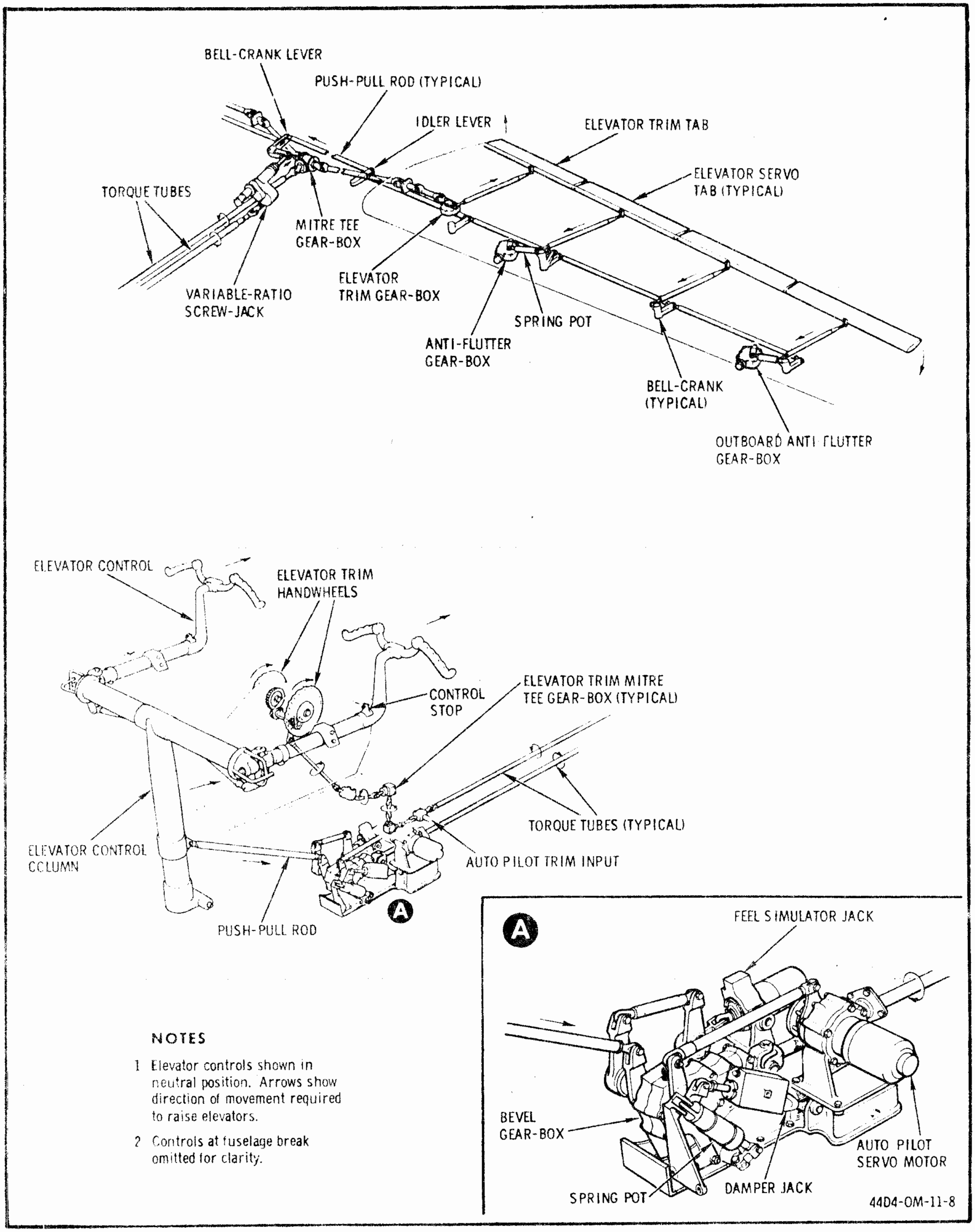
D. Aileron Feel and Trim

Aileron feel is provided by the spring pot on the aileron control unit. The spring pot consists of a cylinder containing a shouldered piston-rod and a compression spring fitted between two sliding pistons. The spring pot assembly is supported at one end by a pivoted fork lever connected via a cross shaft and lever to the trim actuator output shaft. The spring pot piston-rod is attached to a lever on the bevel gear-box input shaft. When the aileron control handwheel is moved, the bevel gear-box input shaft turns and moves the lever connected to the feel spring pot. As the forked lever is held stationary by the trim actuator, the spring pot cannot move and the feel spring is compressed so that the force required to move the handwheel increases with the deflection of the handwheel from neutral.

Aileron trim is accomplished by an electric actuator controlled by a switch on the pilots pedestal. The switch is spring loaded to the OFF position. One end of the trim actuator is anchored to the aileron control unit casting and the other end is attached to the forked lever supporting the spring pot. When operated, the trim actuator exerts a force which is applied through the forked lever and spring pot to the lever on the bevel gear-box input shaft. Operation of the trim actuator thus moves the aileron servo tabs and leaves the control handwheel in a new neutral position. The aileron trim actuator also mechanically drives a trim position transmitter, the electrical output of which operates a trim position indicator, adjacent to the trim switch, on the pilots pedestal.

3. Rudder Control System (Ref. Fig. 3)

Movement of the dual interconnected rudder pedals transmits linear motion through levers and connecting rods to the input lever of a bevel gear-box on the rudder control unit beneath the cockpit floor. The component assembly and operation of the rudder control unit is similar to that of the aileron control unit. The linear input motion is converted by the bevel gear-box to an rotary output motion which is transmitted by torque tubes to a four-way mitre gear-box aft of the wing rear spar. The rotary motion output of the four-way mitre gear-box is conveyed by torque tubes aft to a variable-ratio screw-jack at the base of the rudder and outboard to a bevel gear-box inboard of each aileron. The bevel gear-boxes in the wings and the screw-jack in the stern structure reconvert the rotary motion of the torque tubes to linear motion and operate the aileron No. 1 (inboard) tabs and the rudder tabs by push-pull rods and bell-crank levers to give a combined rudder-aileron movement during turns. The rudder is provided with an anti-flutter gear-box similar in construction and operation to those of the aileron system. A heater jacket, covering the entire rudder jack box, is provided to prevent or overcome jamming of rudder controls caused by freezing of moisture in jack box. The heater operation is controlled by two thermal switches, mounted on the heater



NOTES

1 Elevator controls shown in neutral position. Arrows show direction of movement required to raise elevators.

2 Controls at fuselage break omitted for clarity.

Elevator Control System

Figure 4

jacket, which control the heater elements on demand and by a master switch, marked ON-OFF, located on the systems operators anti-icing control panel. For a description of the control run across the swing tail break, refer to Paragraph 5., following.

Operating handles for individual stature adjustment are mounted on the vertical support members between each pair of pedals.

A. Rudder and Rudder Servo Tab Travel

Nominal rudder travel is 16° and nominal servo tab travel is 18° either side of neutral. Resilient stops are fitted to absorb shock on contact with the vertical stabilizer when the rudder reaches the extremity of travel.

B. Rudder Feel and Trim

Rudder feel is simulated by the rudder feel spring pot of the rudder control unit in a similar manner to that of the aileron spring pot on the aileron control unit.

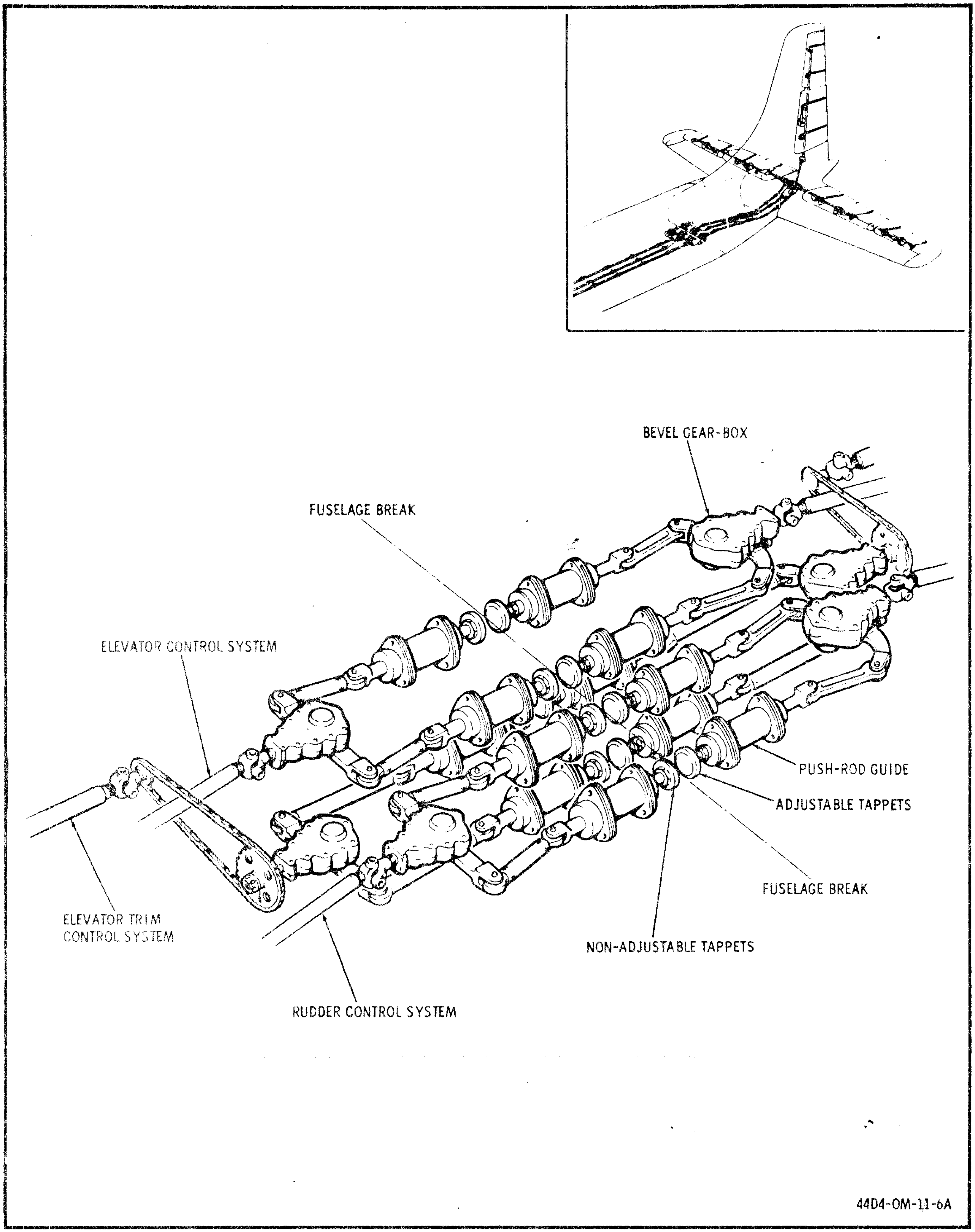
Rudder trim is effected by an electric trim actuator operating through the feel spring pot of the rudder control unit in a similar manner to that of the aileron trim. The trim actuator is controlled by a rudder trim switch on the pilots pedestal, the switch being spring loaded to the OFF position. A trim position indicator is located adjacent to the switch.

4. Elevator Control System (Ref. Fig. 4)

Fore and aft movement of the control column is transmitted by a connecting rod at the lower end of the vertical tube to the input lever of a bevel gear-box on the elevator control unit beneath the cockpit floor. The elevator control unit consists of a bevel gear-box, a hydraulic damper, two centralizing spring pots, a feel simulator jack, an auto pilot servo motor and associated lever assemblies. The control column linear motion is converted by the bevel gear-box into rotary motion which is then transmitted by torque tubes to a variable-ratio screw-jack mounted on the rear spar of the horizontal stabilizer. The variable-ratio screw-jack reconverts the rotary motion of the torque tubes to linear motion and operates push rods and bell-crank levers to which are connected the three outboard servo tab operating rods of each elevator. The elevator range limit stops are mounted on each pilots control tube. The port and starboard elevator servo tabs are interconnected by the operating mechanism, but the elevators are not mechanically interconnected.

A. Anti-float and Anti-flutter Controls

Each elevator is fitted with an anti-float spring to prevent up-float during flight and two anti-flutter gear-boxes for the prevention of servo tab flutter. The anti-float springs and anti-flutter gear-boxes are similar to those of the aileron control system.



Flight Controls Connection at Fuselage Break
Figure 5

B. Elevator Trim System

Elevator trim control is mechanical and is operated manually by two interconnected control wheels, one for each pilot, mounted on the pilots pedestal. The control wheels are connected by gear-boxes, torque tubes, bell-cranks and push-pull rods direct to the inboard tab of each elevator. Indication of elevator trim setting is provided by a mechanically connected pointer adjacent to each handwheel. To provide automatic trim when the auto pilot is engaged, an electric servo motor is coupled to a mitre gear-box in the elevator trim control run. For a description of the elevator and elevator trim control runs across the swing tail break, refer to Paragraph 5., following.

C. Elevator and Elevator Tab Travel

Elevator travel is 30° up and 15° down, resilient stops being fitted to absorb the shock of contact with the stabilizer at the extreme ends of travel. The three starboard outer tabs travel 15° up and 25° down and the three port outer tabs travel 15° up and 25° down. The port and starboard trim tabs travel 17.5° up and 22.5° down.

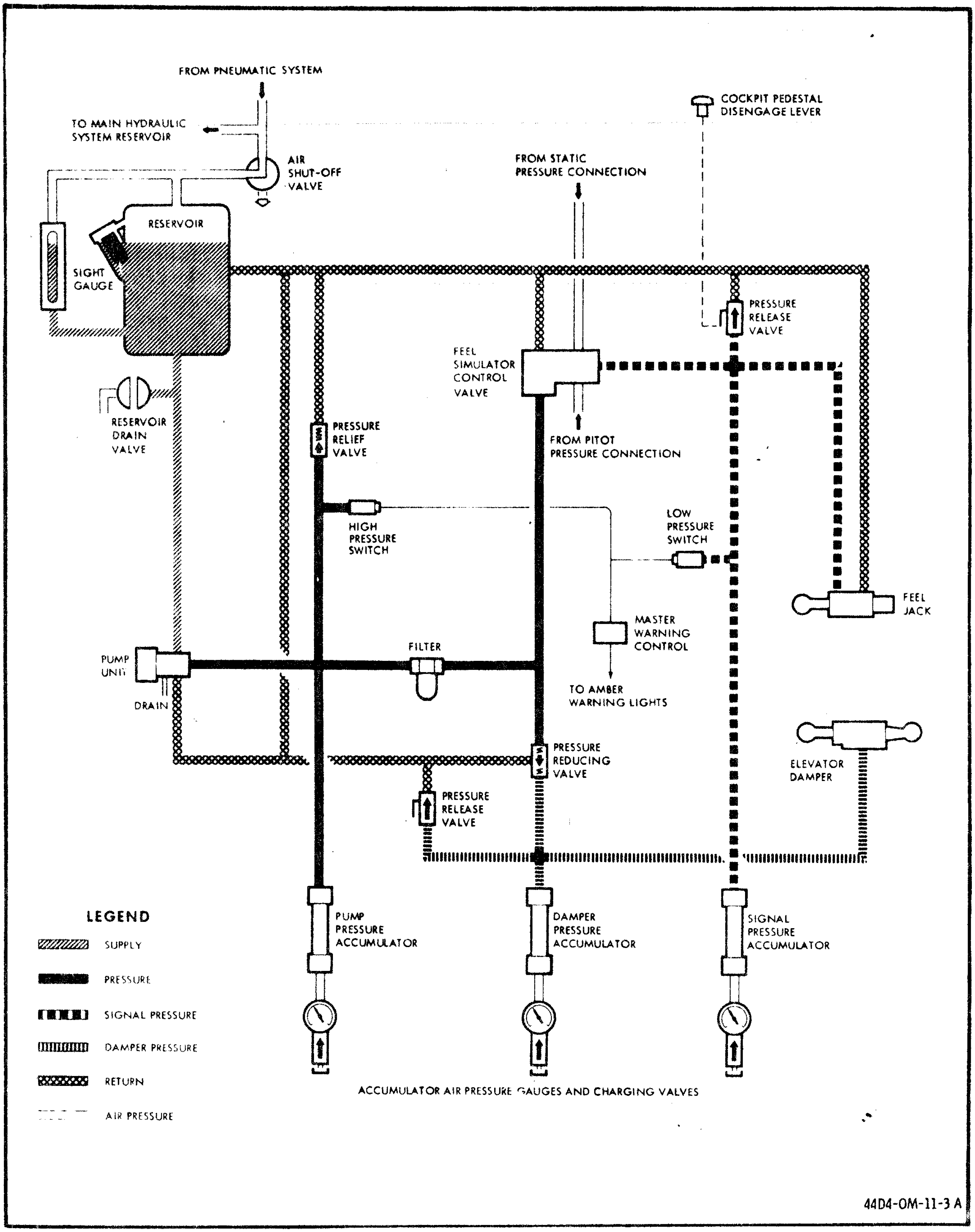
5. Flight Controls at Fuselage Break (Ref. Fig. 5)

The controls for the elevator, rudder and elevator trim pass across the fuselage break and are designed so that, in disconnecting and reconnecting, the correct relationship between the pilots controls and the respective surface controls is maintained. The control of each system across the break is essentially similar.

The aft-going system torque tube from its control unit is connected to a gear-box forward of the fuselage break. This gear-box converts the rotary motion of the torque tube to a relatively small angular movement at the output end of the gear-box. A double-end lever is connected to the output shaft of the gear-box and moves in the horizontal plane, resulting in a push-pull action in a fore-and-aft direction. The ends of the lever transmit this push-pull action through connecting rods to plungers supported in guide bushings beneath the cabin floor. A similar arrangement is installed in the swing-tail section but the operation is reversed.

When the tail is closed, longitudinally adjustable pads on the ends of the plungers contact each other and the control motion is transmitted across the fuselage break. The gear-box in the swing-tail section converts the fore-and-aft movement back to a rotary movement. System backlash is eliminated by the preload provided by the temperature compensators (regulators).

The elevator trim torque tube has approximately twice the rotation of the



Elevator Feel Simulator System - Hydraulic Schematic
Figure 6

elevator primary control torque tube. To accommodate this greater rotary range within the limits of the gear-box, a sprocket and chain drive to the input shaft of the forward gear-box is used to step down the rotary movement. A similar sprocket and chain drive is used to step up the rotary movement from the aft gear-box.

6. Control Surface Position Indicators

A control surface position indicator is provided for each of the main control surfaces, the five indicators being located below and outboard of the pilots instrument panel. Each indicator is part of an independent self-synchronous type system, the five systems being powered through one circuit-breaker.

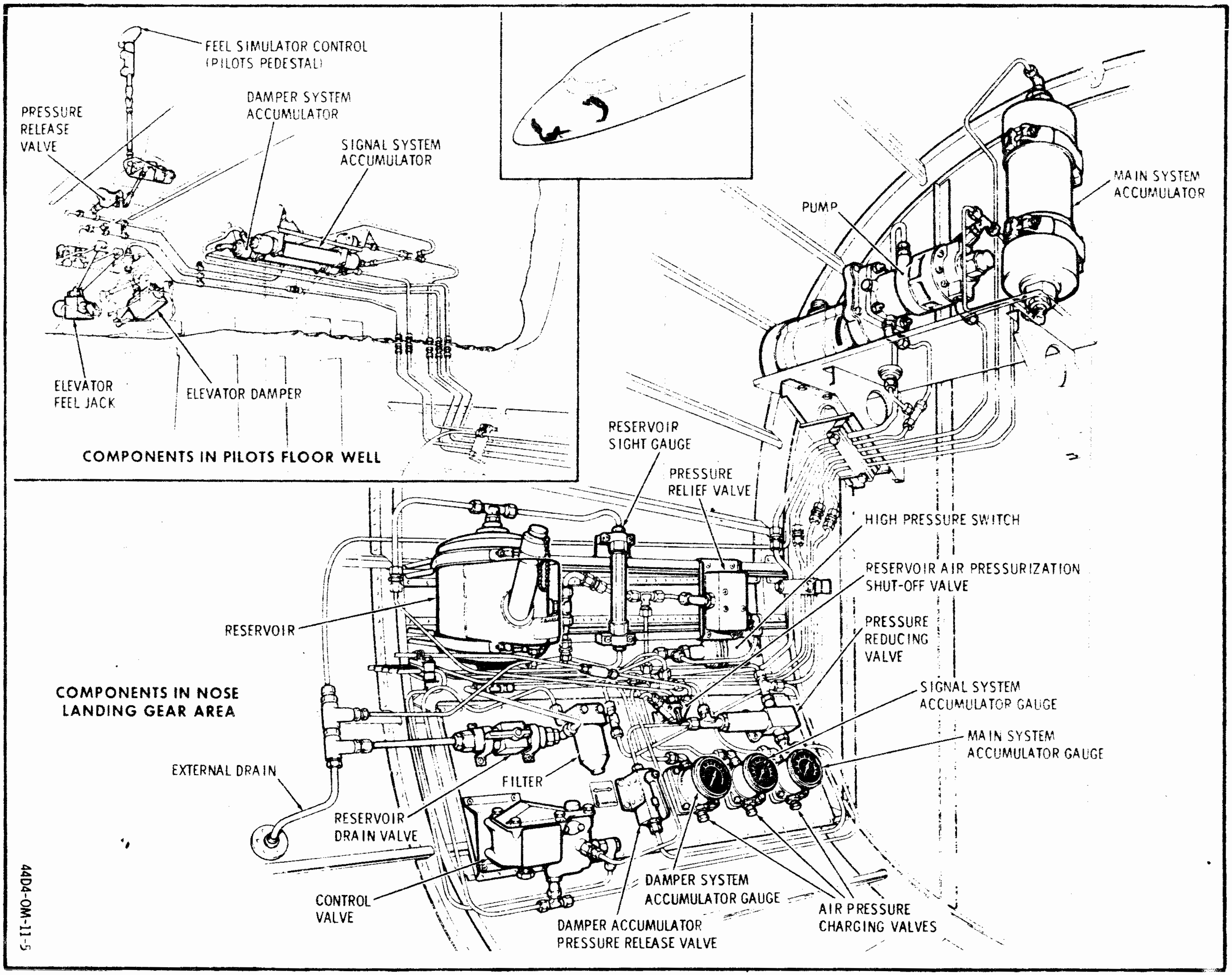
7. Elevator Artificial Feel System

Elevator feel, which varies with control column displacement and airspeed, is supplied by a self-contained hydraulic system (Ref. Fig. 6). The system consists basically of a fluid reservoir, an electrohydraulic pump, a filter, feel simulator control valve, a feel jack, damper, pressure reducing valve and pressure release valves. Accumulators are incorporated in the main fluid supply line, the feel jack supply (signal) line and the damper supply line. The damper line and signal line accumulators, elevator feel jack and elevator damper are located below the cockpit floor. The remaining components of the system are installed in the nose wheel well. A system manual disengage handle is located on the pilots pedestal. For an illustration of component locations, refer to Figure 7.

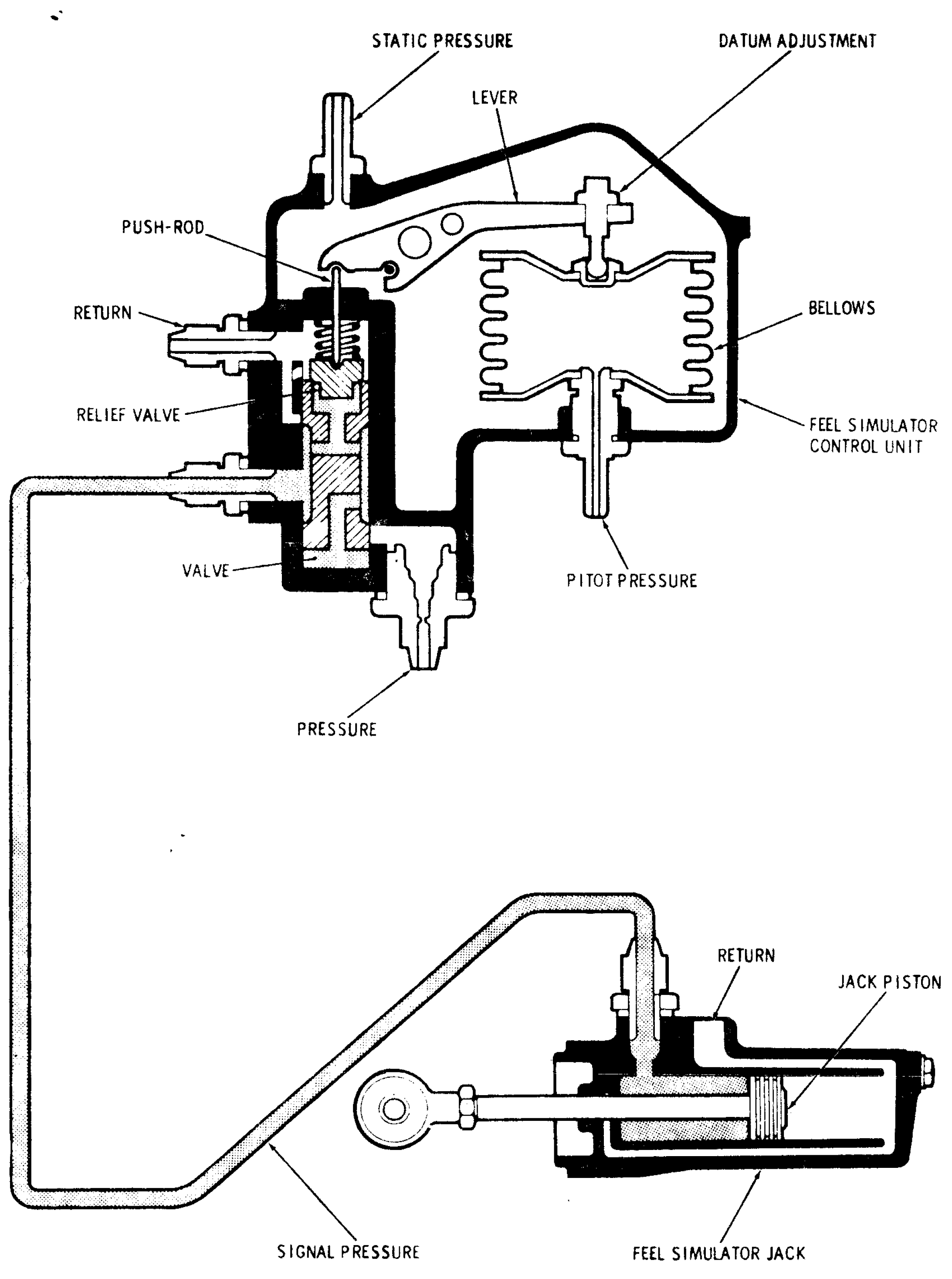
The elevator feel jack on the elevator control unit is linked with the control column. The linkage is so connected that any fore or aft movement of the control column from the neutral position will extend the piston-rod of the feel jack. Extension of the jack will be opposed by the fluid which is supplied under pressure to the jack by the electrohydraulic pump. The fluid is fed to the rod side of the jack piston at a pressure which is governed by the speed of the aircraft. The unit which governs this pressure is the feel simulator control valve.

A. Feel Simulator Control Valve (Ref. Fig. 8)

The feel simulator control valve has two sections, the hydraulic signal pressure section and the dynamic pressure section. A bellows assembly in the dynamic pressure section is subjected to static air pressure on the outside and to pitot pressure on the inside. When the aircraft is moving at speeds at which the pitot pressure is approximately equal to the static pressure, the bellows lever is not held in contact with the push-rod and the only force pushing the control valve down is the relief valve spring. As the speed of the aircraft increases, the bellows assembly will be expanded by the pitot pressure, the bellows end of the lever will be raised


FEEL SIMULATOR CONTROL (PILOTS PEDESTAL)
PRESSURE RELEASE VALVE
DAMPER SYSTEM ACCUMULATOR
SIGNAL SYSTEM ACCUMULATOR
ELEVATOR FEEL JACK
ELEVATOR DAMPER
COMPONENTS IN PILOTS FLOOR WELL
PUMP
MAIN SYSTEM ACCUMULATOR
RESERVOIR SIGHT GAUGE
PRESSURE RELIEF VALVE
HIGH PRESSURE SWITCH
RESERVOIR AIR PRESSURIZATION SHUT-OFF VALVE
PRESSURE REDUCING VALVE
SIGNAL SYSTEM ACCUMULATOR GAUGE
MAIN SYSTEM ACCUMULATOR GAUGE
RESERVOIR
COMPONENTS IN NOSE LANDING GEAR AREA
EXTERNAL DRAIN
FILTER
RESERVOIR DRAIN VALVE
CONTROL VALVE
DAMPER SYSTEM ACCUMULATOR GAUGE
DAMPER ACCUMULATOR PRESSURE RELEASE VALVE
AIR PRESSURE CHARGING VALVES
44D4-OM-11-5

Elevator Feel Simulator System
Figure 7



Feel Simulator Control Valve and Feel Jack - Schematic
Figure 8

and the push-rod forced down. This will cause the control valve to move down to open the fluid port from the pump, allowing fluid to pass to the signal pressure line and to the underside of the control valve. When the pressure in the signal section of the system is sufficient to raise the control valve against the action of the spring and the push-rod, the inlet port will be closed while the return port will be covered.

A decrease in speed will reduce the pitot pressure, allowing the signal pressure to lift the control valve still further until the return port is uncovered. Signal pressure fluid will then be able to escape to the reservoir until the drop in signal pressure allows the push-rod to force the control valve down to a position of balance where both the inlet and return ports are again closed. The control valve will remain in this position until the pressures in the two sections become unbalanced due to an increase or decrease in aircraft speed.

If the control valve sticks in such a position that the inlet port from the pump remains uncovered, the relief valve will operate to prevent excessive pressure being applied to the feel jack.

To maintain correct feel under conditions of low airspeed or small control column displacement from the near-neutral position when feel jack restoration force is low, the feel system is augmented by a spring pot on the elevator control unit linked to the bevel gear-box.

B. Feel Simulator Hydraulic System (Ref. Fig. 6)

The feel system reservoir is pressurized by the pneumatic system. Fluid from the reservoir is fed to a 115/200-volt 400-cycle a.c. motor-driven pump which delivers .25 US (.203 Imperial) gpm at 850 psi to the feel simulator control valve. A pressure relief valve, set to open at 1000 psi, protects the system against excessive pressure. Pressure fluctuations on the pressure side of the control valve are damped out by a main pressure accumulator. A filter in the main pressure line will allow free passage of fluid if the difference between the inlet and outlet pressures at the filter exceeds 50 psi.

A tapping from the main pressure supply line is connected to a pressure reducing valve which supplies fluid pressure at 100 (±10) to a damper connected to the elevator control unit casting. An accumulator is tapped into the damper line to maintain constant pressure in the event of leakage.

The signal pressure line from the feel simulator control valve to the feel jack incorporates a signal pressure accumulator and a pressure release valve. The signal pressure accumulator will dampen pressure fluctuations and prevent sluggish operation. The pressure release valve is controlled by the disengage handle on the pilots pedestal.

Visual warning of system malfunctioning is given by a high pressure switch in the main pressure line to the control valve and a low pressure switch in the line to the signal pressure accumulator. The high pressure switch closes at a falling pressure of 600 (+0, -75) psi and opens at a rising pressure of 800 (+0, -75) psi, and the low pressure switch closes at a falling pressure of 20 psi minimum and opens at a rising pressure of 30(± 5) psi. When either switch is energized, warning is given through the master caution lights and the ART FEEL FAIL window of the annunciator panels.

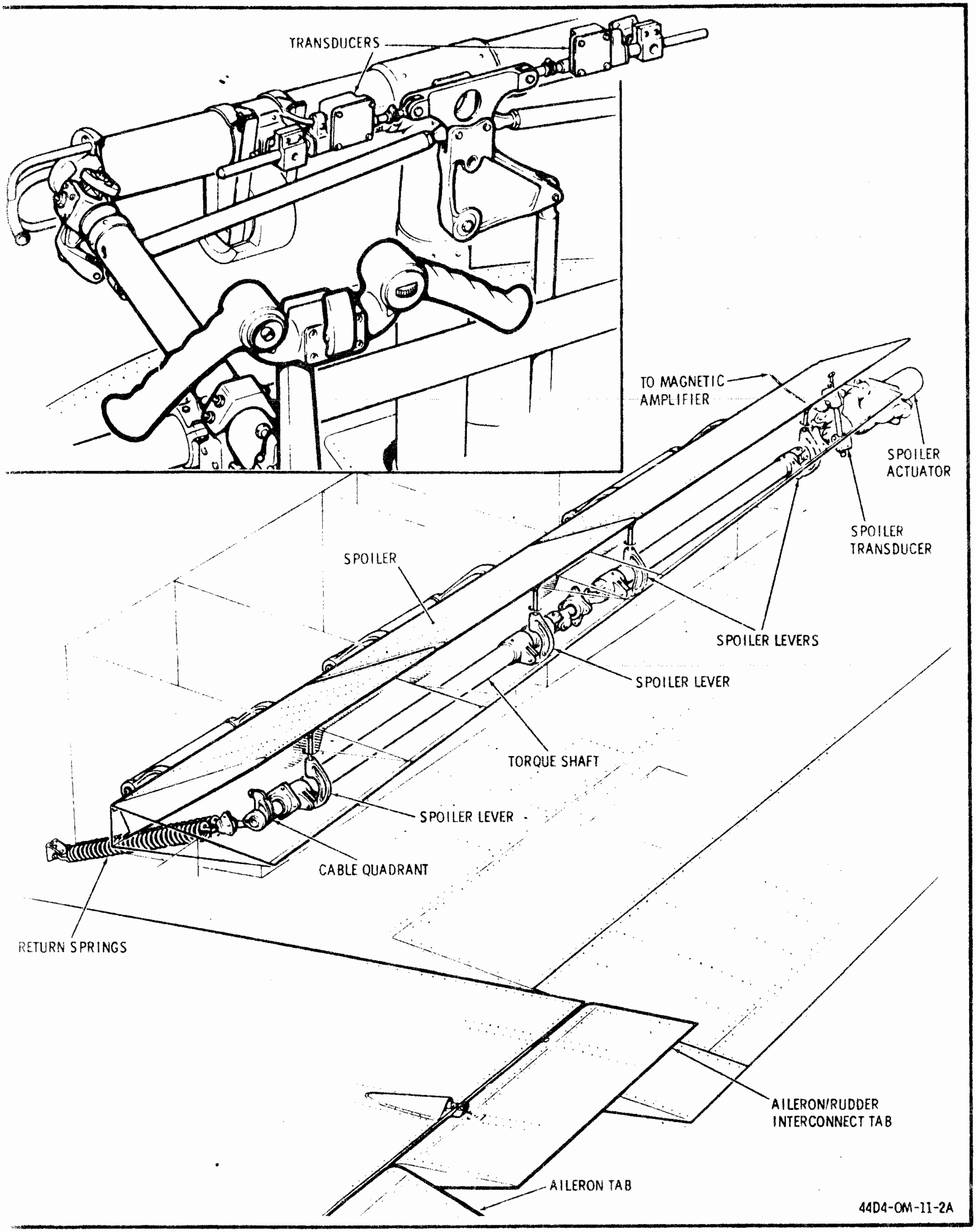
The system control selector handle is mounted on the pilots pedestal and, when in the ENGAGED position, starts the electric motor which drives the hydraulic pump and simultaneously closes the pressure release valve, allowing the system to become pressurized. In the DISENGAGE position, the hydraulic pump is inoperative and the release valve open, depressurizing the system. The handle is normally in the ENGAGE position during all engine running conditions, engine shut-down and engine starts, and is only placed in the DISENGAGE position in the event of system malfunction or for maintenance purposes. Therefore, provided all system circuit-breakers are set, the system will pressurize when power is applied to the aircraft load buses.

C. Damper Unit

The damper unit is provided to restrict the rate at which the elevator controls may be moved. The unit consists of a two-chamber cylinder block, a piston, piston-rod, and a needle valve assembly. One end of the damper is attached to the elevator control unit casting and the piston-rod is attached to a lever on the bevel gear-box of the elevator control unit. Movement of the elevator controls causes the damper piston to move and fluid is displaced from one side of the piston to the other, passing through the needle valve orifice. The needle, which increases or decreases the size of the valve orifice, is controlled by an oil-filled bellows so as to permit a constant flow rate regardless of the temperature of the oil in the damper system.

D. Accumulators

The main system pressure, signal pressure and damper pressure accumulators are of the free-piston type, each with a capacity of 50 cubic inches. They are precharged with air to pressures of 500 psi, 40 psi and 20 psi respectively. Each accumulator has a combined air charging valve and pressure gauge located in the nose wheel well. The gauges indicate the air pressure in the accumulators and the charging valve is utilized for precharging or releasing accumulator air pressure.



Wing Spoiler Operating Mechanism
Figure 9

8. Spoilers (Ref. Fig. 9)

An extendible spanwise spoiler is installed on the upper surface of each wing aft of the rear spar and running between the aileron and the outer nacelle. The spoilers are hinged at the spoiler leading edge and, when retracted, lie flush with the skin surface.

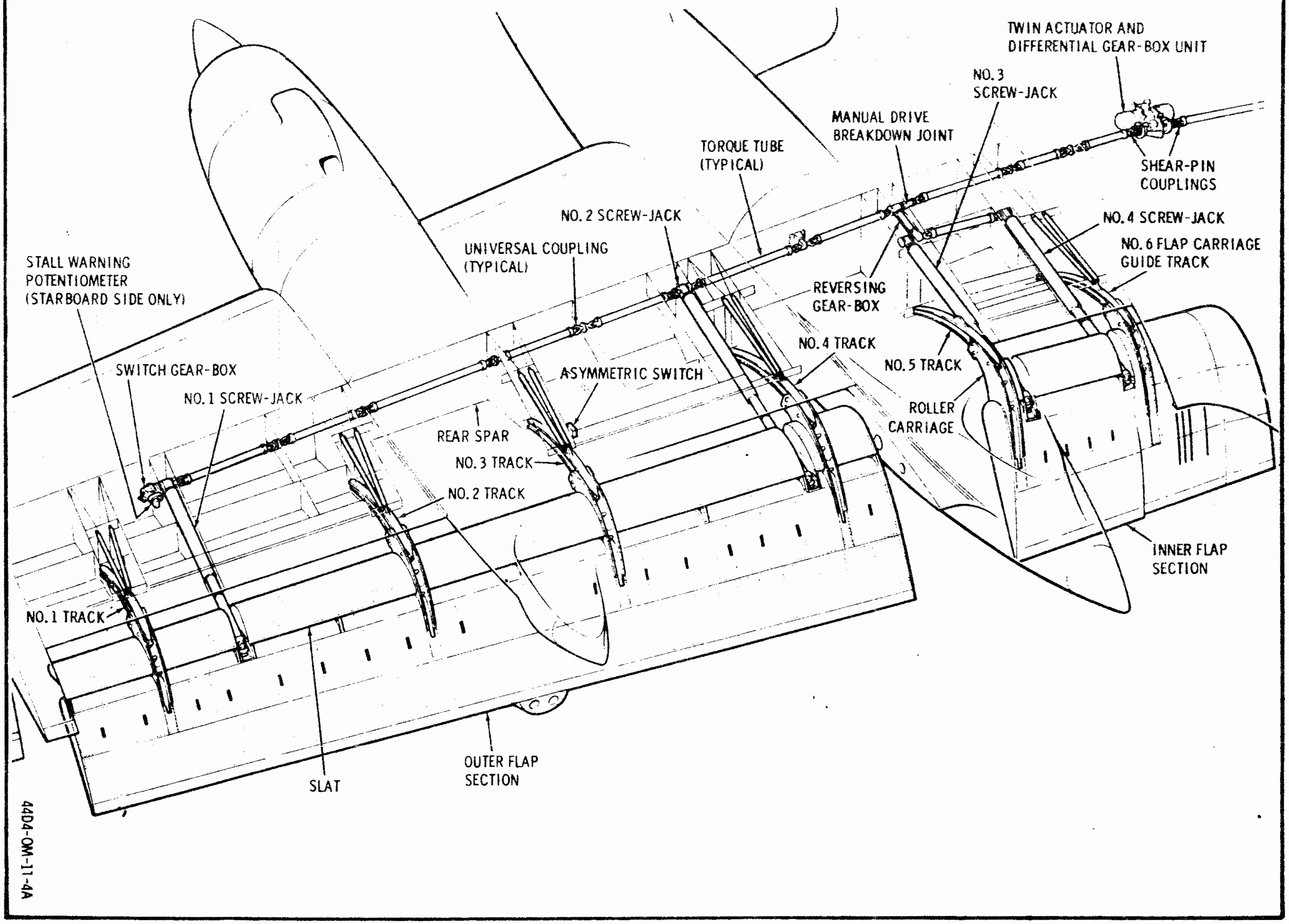
Each spoiler operates automatically as an auxiliary to the up-going aileron, effectively increasing the rate of roll in the lower speed range. The spoilers are effective up to 200 knots IAS. Above this speed and in conjunction with pitot-static pressure, a pressure switch renders the system inactive. Extension of the spoiler is achieved by means of an electric rotary actuator which incorporates a brake and clutch. Retraction is effected by aerodynamic forces and a return spring after release of the actuator brake.

Extension of the spoiler is controlled by transducers which actuate the motor clutch and the brake. At approximately 3° servo tab deflection, the motor is started and at approximately 5° tab deflection, the spoiler begins to open. At tab deflections between 5° and 21°, the spoiler operates proportionately to servo tab displacement up to a maximum spoiler angle of 47-1/2°.

The system is energized by an on-off switch located on the pilots overhead panel. System inoperative warning is provided by the master caution lights and the SPOILER O/SHOOT window of the annunciator panels.

In the event of a spoiler overshoot condition, a microswitch is operated by the actuator to de-energize the spoiler system for the wing on which the overshoot occurs. When the microswitch is operated, the annunciator panel SPOILER O/SHOOT windows are illuminated and the amber master caution lights will flash. The spoiler system on the opposite wing will continue to operate normally. The system which has overshot can be reset, if the spoiler is not mechanically jammed, by placing the wing spoiler switch on the pilots overhead panel to OFF and then returning it to the ON position. If a spoiler is rendered inoperative by system malfunction and normal operation cannot be restored, the system should be switched off for the remainder of the flight, except where the use of opposite spoiler is required due to a spoiler having jammed in the overtravel position.

Two green WING SPOILER READY lights are provided on the control surface position indicators panel in order that the pilot may check operation of the spoilers. The lights will illuminate when the wing spoiler switch is selected ON and the spoiler air pressure switch is closed. Each light will extinguish when its respective spoiler starts to move out and will illuminate again when the spoiler is fully extended.



Wing Flap System
Figure 10

9. Wing Flaps (Ref. Fig. 10)

The wing flaps are of the double-slotted Fowler type, running on curved tracks in the wing trailing edge. Each flap has an inner and an outer section and each section is fitted with two screw-jacks. The flaps are operated by an actuator unit driving spanwise torque tubes which are attached to the screw-jacks. The screw-jacks convert the rotary motion of the torque tubes to a linear movement to operate the flaps.

The actuator unit is mounted on the rear spar in the fuselage and consists of twin reversible three-phase 115/200-volt a.c. motors attached to a common gear-box and differential unit. In the event of failure of one of the motors, the flaps can still be operated but will function at half the normal speed. A shear-pin coupling is mounted in the output shaft at each end of the actuator unit. Excessive loads caused by jamming or mechanical failure will shear the pin and the actuator will automatically shut off, thus preventing asymmetrical flap travel. Synchronized switches installed at the outer flaps cut power to the actuators if an asymmetric condition occurs, thus assuring that no more than 3° of asymmetric flap can result. In the event of failure, the flaps will remain at the position at which failure occurred. A breakdown joint is provided in the torque tube run, inboard of the reversing gear-box on each side. A manual drive handle can be fitted at the breakdown joints to permit manual raising or lowering of the flaps during ground servicing. Manual operation is not possible in flight. Limit switches and a position transmitter are mounted on the outboard end of the torque tube run.

A. Flap Controls

Normally, the flap positions are selected by a four-position selector located on the control pedestal. A master switch group is mounted on the cockpit lower centre instrument panel and consists of a two-position normal/alternate switch and a spring-loaded inching switch. With the normal/alternate switch in NORMAL, the normal selector can select the flaps to any one of four positions: UP, 15°, 30°, 45°. When ALTERNATE is selected, the inching switch is used and any flap setting between 0° and 45° may be attained.

10. Control Surface Locks

When the aircraft is on the ground, the ailerons, elevators and rudder can be locked to prevent damage by wind buffeting. The control surfaces are locked or unlocked by actuators mounted to the aircraft structure and attached pivotally to the respective control surfaces in the vicinity of the centre hinges. Hydraulic pressure fluid from the main hydraulic system is directed to the required port of each actuator by a single selector valve. Each actuator incorporates an integral mechanical locking device which will maintain the actuator in the locked position should hydraulic pressure fail, or the main hydraulic system be unloaded, after the locks have been applied. When any control surface is locked, a microswitch mounted on the actuator operates all amber master caution lights and also the SURFACE LOCK windows on the annunciator panels. These lights remain illuminated until all control surfaces are unlocked.

A two-position operating lever on the pilots pedestal is mechanically connected to and controls the selector valve. The lever is also interconnected with the power levers in such a way as to prevent the application of full power to more than one engine on each side when the lever is in the LOCKED position. A solenoid-operated latch prevents the control lever being moved to LOCKED when the weight of the aircraft is not supported by the landing gear, thus preventing the application of the control surface locks during flight. The solenoid is energized to release the latch and free the control lever when the ground safety relay circuit is closed. A gust lock by-pass system is controlled by a switch marked "GROUND/AIR". When in the "AIR" position, hydraulic pressure to the gust lock selector valve is routed directly to return.

To operate the system, the main hydraulic system must be pressurized, the weight of the aircraft resting on the landing gear and power on the electrical bus system. One or both of the power levers on each side must be retarded to or below the flight idle position, and the by-pass system switch to ground.

When the control lever is moved to LOCKED, the selector valve directs hydraulic pressure to the locking ports of the actuators, and at the same time opens the unlocking ports to return. The mechanical linkage engages the power lever stops. Moving the control lever to UNLOCKED reverses the connections of the pressure and return lines to the actuator ports and withdraws the power lever stops.

11. Prestall Warning System

Warning of the stall, especially in the flaps down configuration, is not easily discernible, the natural buffet being negligible and too near the stall to provide early enough indication to allow the pilot to take corrective action. An electrically operated prestall warning unit provides this warning by vibrating the control column when the aircraft speed is 10% (± 3%) or less above the stalling speed. The stick shaker is controlled by a lift computer which receives signals from a lift transducer. The transducer responds to variations of the angle of attack of the wing. The operation of the system is unaffected by variables such as power settings, aircraft weight or air density.

A. Components and Component Location

A lift transducer is mounted within the underside of the starboard wing leading edge and a flap position transmitter is mounted at the outboard end of the starboard flap torque tubes. A lift computer is located below the systems operators table and a stick shaker is mounted on the control column. A prestall warning system test switch is provided on the pilots overhead panel.

B. Aerodynamic Operation

The angle of attack at which a specific wing stalls is a constant. It is unaffected by the aircraft weight, airspeed or air density, therefore it is necessary to measure only the angle of attack to detect the approach of the stalling angle. This is done by the use of a device which responds to movement of the stagnation point (the point at which the air divides to flow over and under the wing). The stagnation point moves aft on the lower side of the wing as the angle of attack increases. The vane of the lift transducer, spring-loaded to the neutral position and projecting from the wing in the area of movement of the stagnation point, will sense the movement of the stagnation point as the wing approaches the stalling angle. The movement of the vane will cause an imbalance of electrical circuits within the lift computer. When the critical angle of attack is reached, the imbalance of the circuits will be sufficient to operate a relay and so energize the stick shaker.

To compensate for the alteration in the angle of attack due to the effect of the flaps when extended, a flap potentiometer with a resistance proportional to the flap angle is used. The resistance is connected to one of the circuits in the lift computer so that the lift transducer has to assume a different position to unbalance the circuits sufficiently to enable the stick shaker to operate.

Operation of the test switch will unbalance the circuits within the lift computer to simulate a stall condition.

The system test switch is used to test the serviceability of the system in the air or on the ground. Placing the switch to TEST will energize the stick shaker.

Power for the system is derived from the d.c. and a.c. supply. Anti-icing heat for the lift transducer is a permanent feature during flight. The stick shaker and heater supply are de-energized by the ground safety relay when the main gear shock struts are compressed.

12. Power Sources

The power sources and circuit-breakers for the flying control systems are as follows:

(1) Constant-frequency Bus Panel A	Quantity
Wing Flap Motor Power RH	3
(2) Constant-frequency Bus Panel B	
Wing Flap Motor Power LH	3
Artificial Feel System	3
Wing Spoilers LH and RH	6
Wing Spoilers Control	1
Pre-stall Warning Computer	1
Rudder Jack Box Heater	1
(3) D.C. Main Bus	
Rudder and Aileron Trim Off Load	1
Trim Tab Position Indicator - Rudder	1
Trim Tab Position Indicator - Aileron	1
Surface Position Indicators	1
Spoiler Warning Light and Overshoot Relay	1
Artificial Feel Pump Control	1
Wing Flap Normal Control - Main	1
Wing Flap Normal Control - Auxiliary LH and RH	2
Control Surface Lock Indicator	1
Gust Lock and Landing Gear Solenoid	1
(4) D.C. Essential Bus Panel A	
Artificial Feel Low Pressure Warning	1
Pre-stall Warning	1
Wing Flap Position Indicator	1
Wing Flap Alternate Control - Main	1
Wing Flap Alternate Control - Auxiliary LH and RH	2

SECTION 12

HYDRAULIC AND PNEUMATIC SYSTEMS

1. Hydraulic System

A. General (Ref. Fig. 1)

The hydraulic system is a 3000 psi closed-centre type, operating the following aircraft services: landing gear, nose wheel steering, wheel brakes, gust locks, cargo door, swing tail, and the cabin supercharger disconnect.

B. Main Power System

The hydraulic main power system consists of a reservoir, two engine-driven constant-delivery pumps, a pressure regulator, a pressure relief valve, a system unloading valve, an accumulator, a pressure indicator, and two filters, one in pump pressure line and one in return to reservoir line.

C. Hydraulic Reservoir

The hydraulic reservoir is located in the rear of No. 1 nacelle and supplies hydraulic fluid to the engine-driven pumps, the auxiliary pump and the hand pump. It is of welded aluminum alloy construction with a fluid capacity of 7.3 US (6 Imperial) gallons and an air space of 3.2 US (2.7 Imperial) gallons.

Separate outlets are provided for the supply lines to each of the engine-driven pumps. A single outlet supplies the auxiliary pump and the hand-pump and is also the return line from both the main landing gear and brake systems. The system main return connects into the upper part of the reservoir through a filter and a check valve.

The reservoir is pressurized at 12 to 14 psig by the aircraft pneumatic system. The air is fed into the reservoir through a two-position three-way shut-off valve which enables the pressure to enter the reservoir or be shut off and the reservoir vented to atmosphere for servicing purposes. A sight glass with a placard permits the level of the fluid in the reservoir to be checked with the system accumulators pressurized or unpressurized. To allow the reservoir air pressure to be checked, a pressure gauge is located adjacent to the reservoir.

D. Hydraulic Fluid Firewall Shut-off Valve

An electrically operated gate-type shut-off valve is installed in the suction line to each engine-driven pump. The two valves are located on the aircraft firewall in the No. 1 and No. 2 engine nacelles. Each valve is controlled by its respective engine condition lever and is closed when the condition lever is placed in the firex arm position and is opened when the lever is moved from the firex arm position. Each valve is driven by an integral electric motor and when power is removed, the valve will remain in the last selected position. Electric power for the operation of the valves is taken from the 28-volt d.c. emergency bus.

E. Engine-driven Pumps

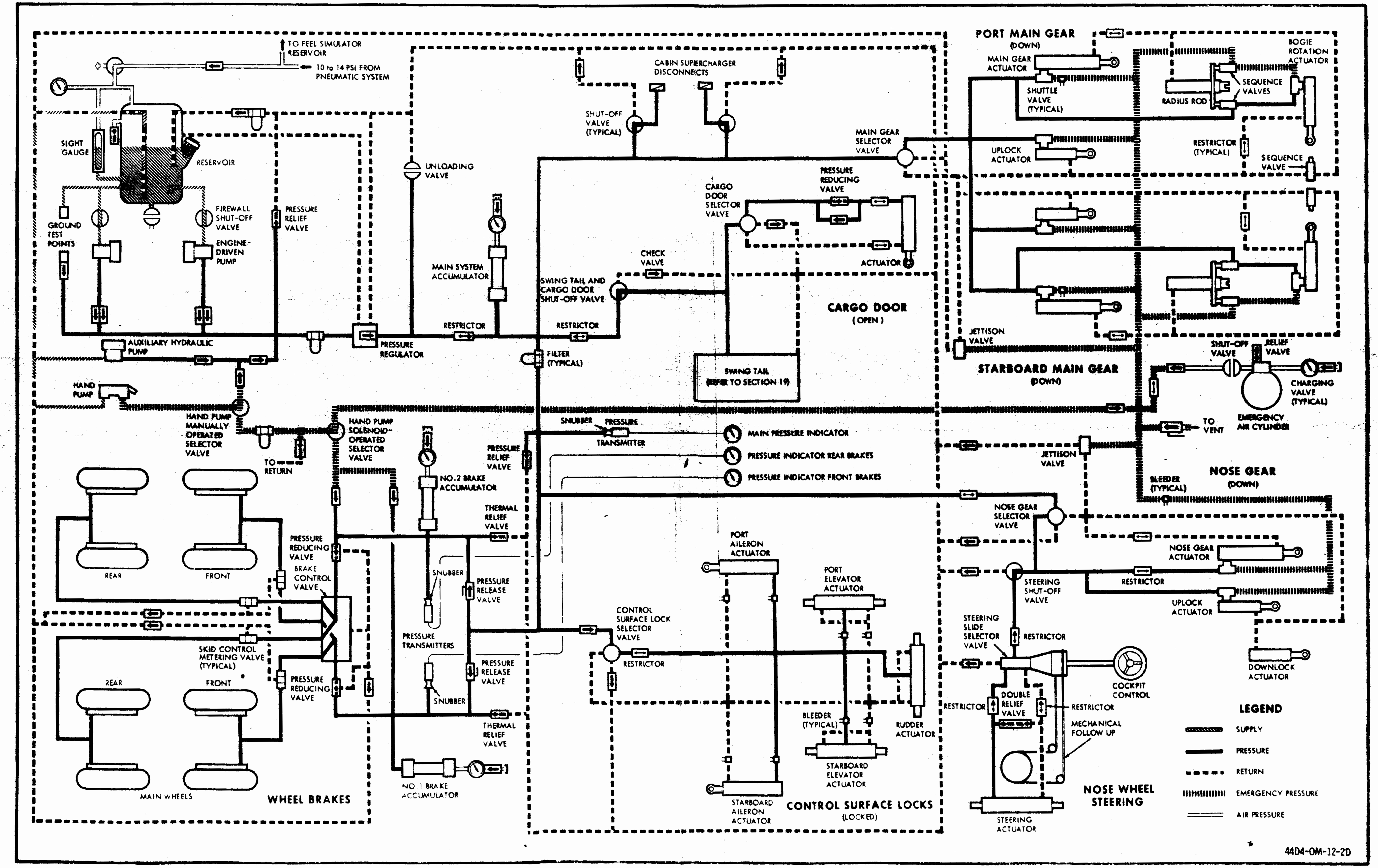
Two constant-displacement piston-type pumps provide the normal power supply for the hydraulic power system. The pumps are mounted on and driven by the constant speed drive units of engines No. 1 and No. 2. The output of each pump is approximately 10.7 US (9 Imperial) gpm at an output pressure of 3000 psi. The pressure supply from each pump is directed through a double check valve into a common line to the pressure filter and the pressure regulator.

F. Unloading Valve

The unloading valve is a two-way solenoid-operated shut-off valve controlled by a switch on the systems operators hydraulic control panel. When the switch is at LOAD, the solenoid is de-energized and the valve is closed, allowing pump output to pressurize the system. With the switch at UNLOAD, the solenoid is energized, directing pump output to the return system and releasing main system pressure. To prolong the life of components in the system, the valve should be in the UNLOAD position when hydraulic power is not required.

G. Pressure Regulator

The pressure regulator, located in the No. 1 nacelle, controls the output from the engine-driven pumps, the auxiliary pump and the handpump to maintain the power system pressure between 2600 and 3000 psi. When any of the pumps are operating and the unloading valve is closed, flow is directed through the regulator to charge the system accumulators to the upper limit. At this pressure, the regulator cuts out to route pump output back to the reservoir and retains the pressure in the system through a check valve. When the system pressure falls to the low limit, the regulator cuts in to direct pump output to recharge the power system to 3000 psi.



Hydraulic System - Schematic
Figure 1

H. Main Accumulator

The main system accumulator is located in the No. 1 engine nacelle and a pressure gauge is adjacent to it. The accumulator, when charged, insures that pressure fluid is immediately available at all times. It also damps out surges and fluctuations in pressure and provides a pressure source for the operation of the pressure regulator.

I. Auxiliary Power Supply

In the event of a failure or shutdown of the engine-driven pumps, auxiliary power is available from a handpump or an electrically driven pump.

J. Hydraulic Handpump (Ref. Fig. 2)

The handpump is provided primarily as an emergency means of operating the wheel brakes and lowering the landing gear but, if necessary, it can be used to pressurize the complete system for the operation of all services.

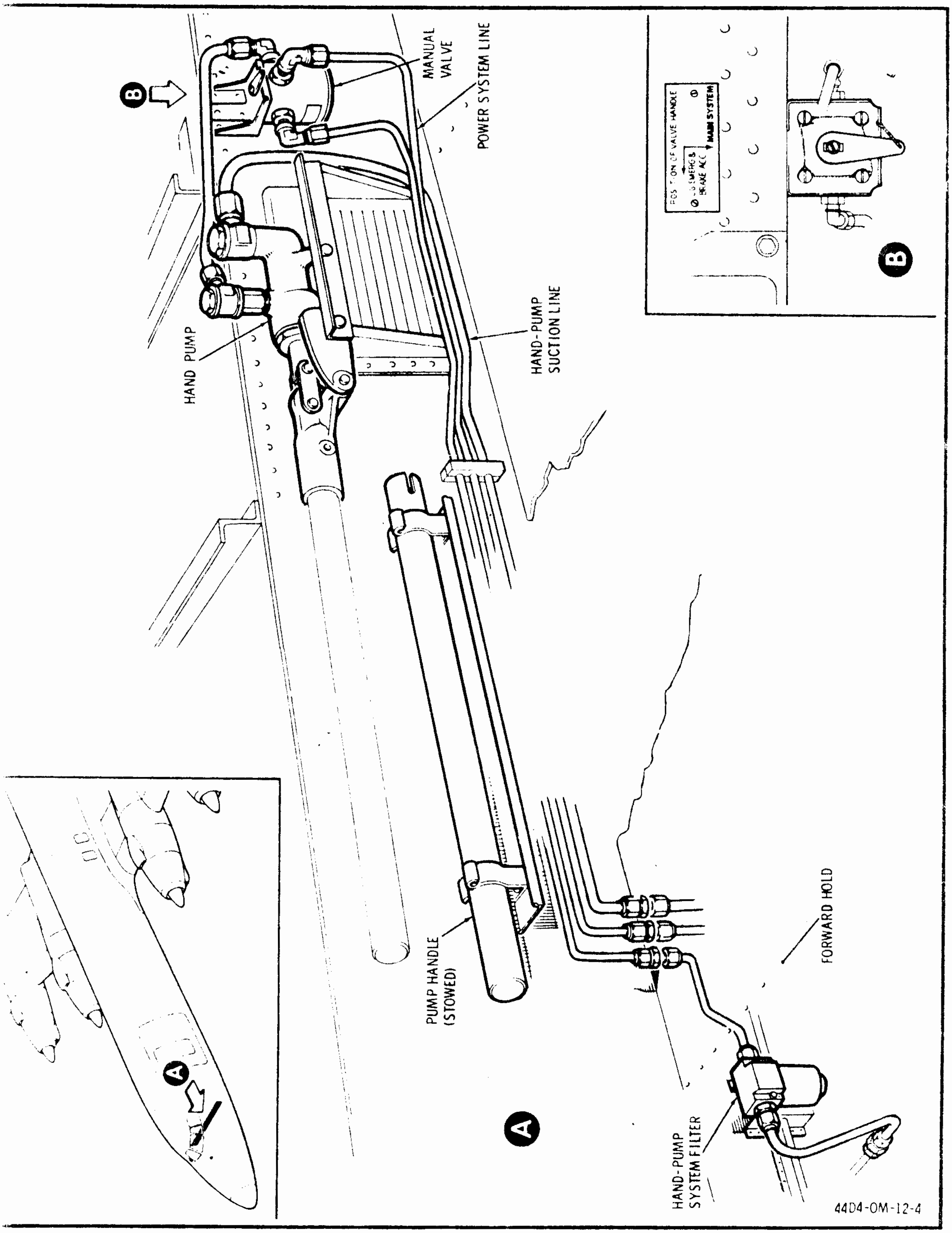
Two selector valves are installed in the handpump output line to determine the direction and use of pressure generated by the pump. The first of these is a manually operated two-position valve, the control lever of which is at the right of the handpump and is safety-wired in the position marked MAIN SYSTEM. In this position, the pump output is directed into the hydraulic power system to supply pressure for the operation of all services. With the manual valve lever set to L.G. EMERG & BRAKE position, pressure fluid is directed to the second selector valve.

The second valve is a solenoid-operated valve, the function of which is to receive pressure fluid from the manual valve and direct it to the landing gear for emergency lowering or, alternatively, to the two brake accumulators. The control switch for this valve is located on the systems operators hydraulic control panel and is normally in the LANDING GEAR position, de-energizing the solenoid. The other position for the switch is marked EMERG. BRAKES and in this position the solenoid is energized.

The handpump is located at the systems operators station immediately behind the co-pilots seat. The handpump operating handle is normally removed from the pump and is stored in clips adjacent to the pump.

K. Auxiliary Hydraulic Pump

The auxiliary hydraulic pump, located in the forward hold area, consists of a constant-displacement pump driven by an electric motor and has an output of 4 US (3.4 Imperial) gpm at a pressure of 3000 psi. Pressure output from the pump is fed directly into the main power system. The



Hydraulic System Handpump
Figure 2

unit is installed primarily to provide pressure for the ground operation of the swing tail and the cargo door, but can be used to power any of the hydraulic services if operation of the handpump is not practicable. The pump is operated from either of two switches, one at the systems operators hydraulic control panel and the other at the swing-tail control panel. Placing either switch to the ON position energizes the pump.

On some aircraft the motor is powered from the 28-volt d.c. essential bus; on others, the motor is powered from the 115/200 volt a.c. constant-frequency bux A on the main distribution panel.

L. Hydraulic Pressure Indicators (Ref. Fig. 3)

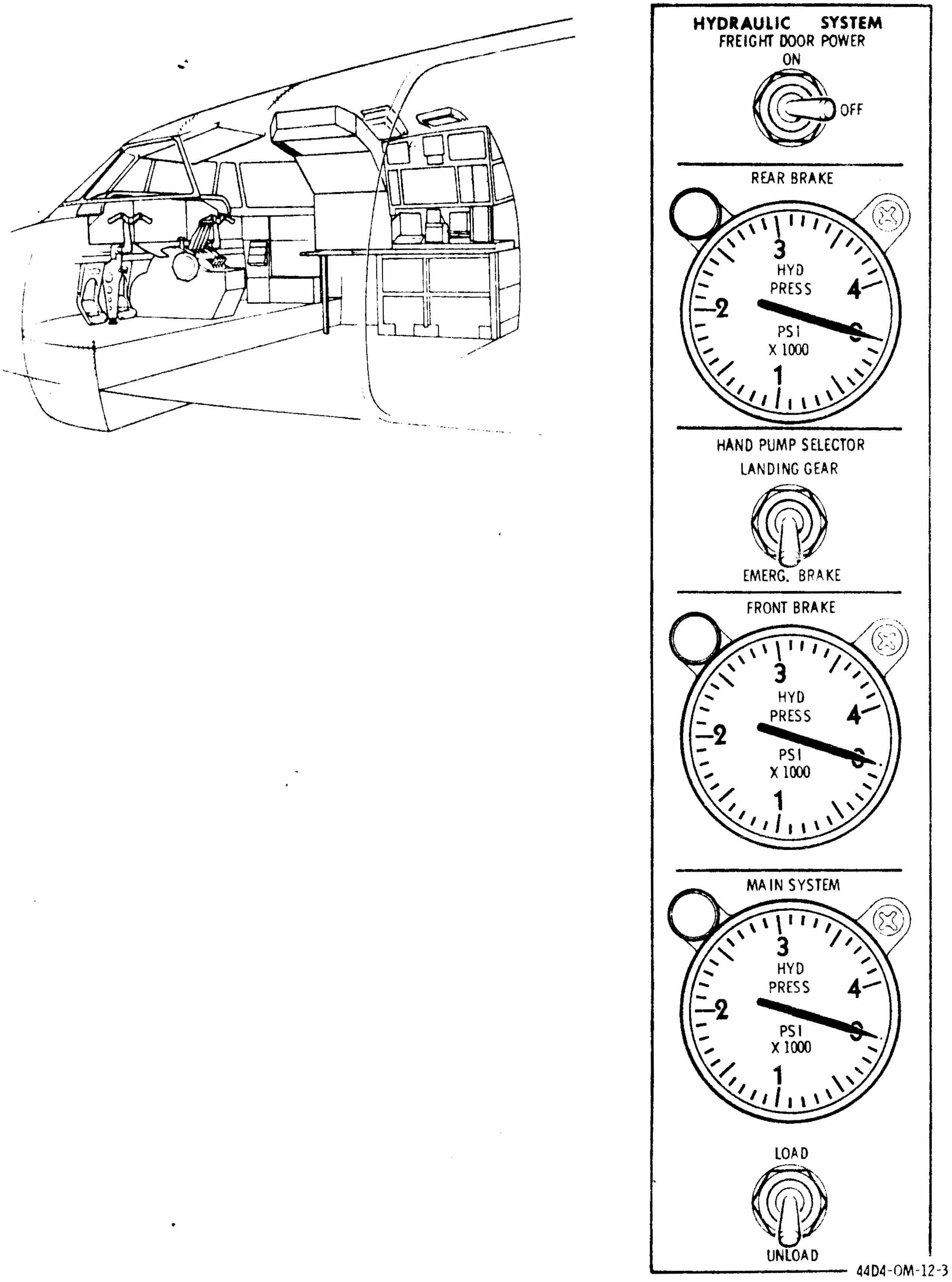
The hydraulic pressure indicator is located on the systems operators hydraulic control panel and is marked MAIN SYSTEM. A synchro-type transmitter and a 115/26-volt transformer are incorporated. Power for the system is supplied from the A phase of the a.c. bus to the transformer on the main distribution panel. The 26-volt a.c. is supplied to the indicating system.

Two gauges on the hydraulic control panel, marked FRONT BRAKE and REAR BRAKE, indicate hydraulic pressure in the brake accumulators. They operate in a similar manner to the hydraulic pressure indicator.

M. Power Sources

The circuit-breakers and power sources for the hydraulic system are as follows:

		Quantity
(1)	Constant-frequency Bus Panel A	1
	Swing Tail Hydraulic Pump (As required)	1
	Hydraulic Pressure Indicator	1
(2)	D.C. Essential Bus Panel A	1
	Hydraulic System - Emerg. Ldg Gear Sel. Valve	1
	Hydraulic System - Hyd. Pump & Unload Valves (As required)	1
	Hydraulic System - Freight Door Valve	1
(3)	D.C. Main	1
	Hyd. Pump Motor Control	1



Hydraulic Control Panel
Figure 3

2. Pneumatic Systems

A. General

The system supplies pneumatic pressure to the air conditioning control system, the main hydraulic reservoir, the artificial feel system hydraulic reservoir and the swing-tail joint seal. When required, engine bleed air is utilized to supply the jet pumps of the controller and outflow valves of the aircraft pressurization system.

The pneumatic system is normally pressurized to altitudes of approximately 25, 000 feet by means of engine bleed air tapped from Nos 2 and 3 engine LP compressors. When bleed air pressure is inadequate, the pneumatic system is pressurized by either of two electrically driven pumps which are identified as standby pump 1 and standby pump 2. Selection of standby pump 1 is automatic or manual, while selection of standby pump 2 is manual only.

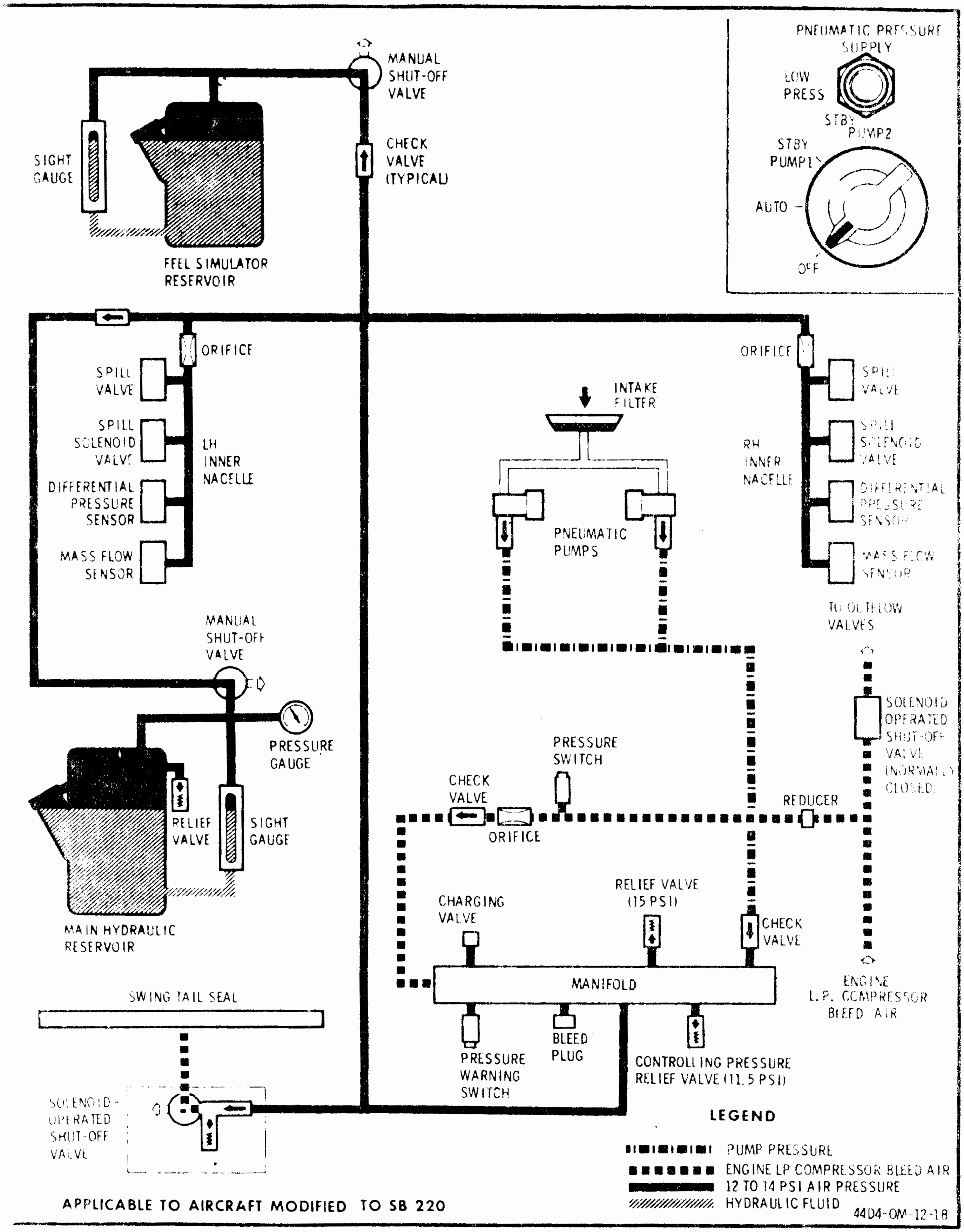
The system is controlled by a single rotary switch. A warning light to indicate low pneumatic pressure is controlled by a pressure switch mounted on the manifold. For a schematic of the pneumatic system, refer to Figure 4.

B. Components and Locations

The system consists basically of a control switch, a low pressure warning light, a solenoid-operated shut-off valve, an intake filter, a power pack, and plumbing through which the compressed air is distributed to the services. The equipment location is as follows: the control switch and the warning light are located on the systems operators panel; the solenoid shut-off valve is introduced in the engine bleed line to the pressurization controller and outflow valves; the intake filter is mounted on the forward face of the rear bulkhead in the forward hold, and the power pack is located in the unpressurized interhold area. In addition, there are two manual shut-off valves, one for the main hydraulic system reservoir and one for the artificial feel system hydraulic reservoir, and also a pressure gauge to allow checking of air pressure to the main hydraulic system reservoir. The manual shut-off valves are located one in the nose wheel well and one in No. 1 nacelle. The pressure gauge is located in No. 1 nacelle.

C. Power Pack

The power pack is connected to the intake filter and to the LP compresso bleed from engines Nos 2 and 3. The power pack consists of two electrically driven pneumatic pumps identified as standby pump 1 and standby pump 2, a manifold, two pressure relief valves and two pres-



APPLICABLE TO AIRCRAFT MODIFIED TO SB 220

Main Pneumatic System - Schematic
Figure 4

sure switches. Each pump is driven by a 1/2-hp electric motor and is capable of supplying 3 scfm minimum at 11 to 14 psig to the services at sea level. The manifold mounts a controlling relief valve, a pressure relief valve, a bleed plug, a pressure switch, two check valves, one for engine bleed inlet and one for pump inlet, and a charging valve. The controlling and pressure relief valves are similar valves set to relieve at different pressures, the controlling valve opening at 11.5 (±.5) psi and the pressure relief valve at 15 (±1) psi. The pressure switch for the warning system closes the warning light circuit when pressure in the manifold falls below 7.5 (±.5) psi and breaks the circuit when the pressure is above 9 psi. Standby pump 1 is automatically cut in by a pressure switch when bleed air pressure falls to 9 (±.5) psi and cuts out when pressure rises to 11 psi.

D. System Control and Indicators

Operating controls for the pneumatic system consist of a rotary control switch and an amber warning light, both located on the systems operators overhead panel. The control switch, marked OFF-AUTO-STBY PUMP 1 - STBY PUMP 2, provides automatic pressurization of the system by engine bleed air with standby pump 1 acting as standby source of pressurization or, alternatively, manual selection of either standby pump 1 or standby pump 2. The warning light illuminates when pneumatic pressure drops below 7.5 (±.5) psi.

E. System Operation

Engine bleed air or, alternatively, a pneumatic pump is used to pressurize the pneumatic system. Air for the pneumatic pump is drawn through the filter-equipped intake, while engine bleed air is derived from Nos 2 and 3 engine LP compressors, with standby pump 1 acting as an alternate source of pressurization, this pump being automatically cut in by a pressure switch when pressure drops below the predetermined setting. Compressed air from the selected source passes to the pneumatic system manifold where the pressure is regulated by the controlling relief valve and the pressure relief valve. The controlling relief valve, which is set to relieve at the lower pressure, acts as the initial pressure control valve. From the manifold, air is routed to the various services at a nominal pressure of 12.5 to 14.25 psi.

When the rotary switch is placed to AUTO, engine bleed air and standby pump 1 are available for the pneumatic services. The pump is automatically cut in by the pressure switch located in the bleed air supply line to the power pack. Manual selection of standby pump 1 or standby pump 2 brings the respective pump into operation and opens the solenoid-operated valve in the line to the aircraft pressurization system jet pumps.

NOTE: LP compressor bleed air is available at all times, the rotary switch having no control over engine bleed air apart from opening or closing the solenoid-operated shut-off valve.

F. Electrical Operation

On some aircraft, each pneumatic pump motor is operated by d.c. power and is controlled through a relay actuated by selection of the rotary control switch On other aircraft, each pneumatic pump motor is operated by a.c. power controlled by a d.c. relay. Operating positions of the rotary switch provide continuity from the 28-volt d.c. essential bus A to the low pressure warning switch. Power to standby pump 1 relay is supplied through the control switch in the STBY PUMP 1 position, and through the switch and engine bleed air low pressure switch in the AUTO position. Power is supplied through the rotary switch to standby pump 2 relay only in STBY PUMP 2 position. The engine bleed air solenoid valve is energized to open when either standby pump is selected.

G. Power Sources

The power sources and circuit-breakers for the pneumatic system are as follows:

	Quantity
(1) Constant-frequency Bus Panel A	
Pneumatic System Standby Pump 1 (As Required)	3
(2) Constant-frequency Bus Panel B	
Pneumatic System Standby Pump 2 (As Required)	3
(3) D.C. Main Bus	
Pneumatic System Standby Pump 1 (As Required)	1
(4) D.C. Essential Bus Panel A	
Pneumatic System Control and Low Press Warning (As Required)	1
Pneumatic System Control and Low Press Warning (As Required)	1
Pneumatic System Standby Pump 2 (As Required)	1

SECTION 13

ICE AND RAIN PROTECTION

1. Ice and Rain Protection

A. General

The aircraft anti-icing and de-icing systems consist of the following:

(1) A thermal system for the wing leading edges using hot air heated by the engine jet pipes.

(2) A thermal system for the empennage leading edges using hot air heated by combustion heaters.

(3) Electrothermal systems for the propellers, spinners, engine intake cowls, nacelle scoops, fin scoop, elevator horn balances, windshields, pitot tubes and rudder jack box.

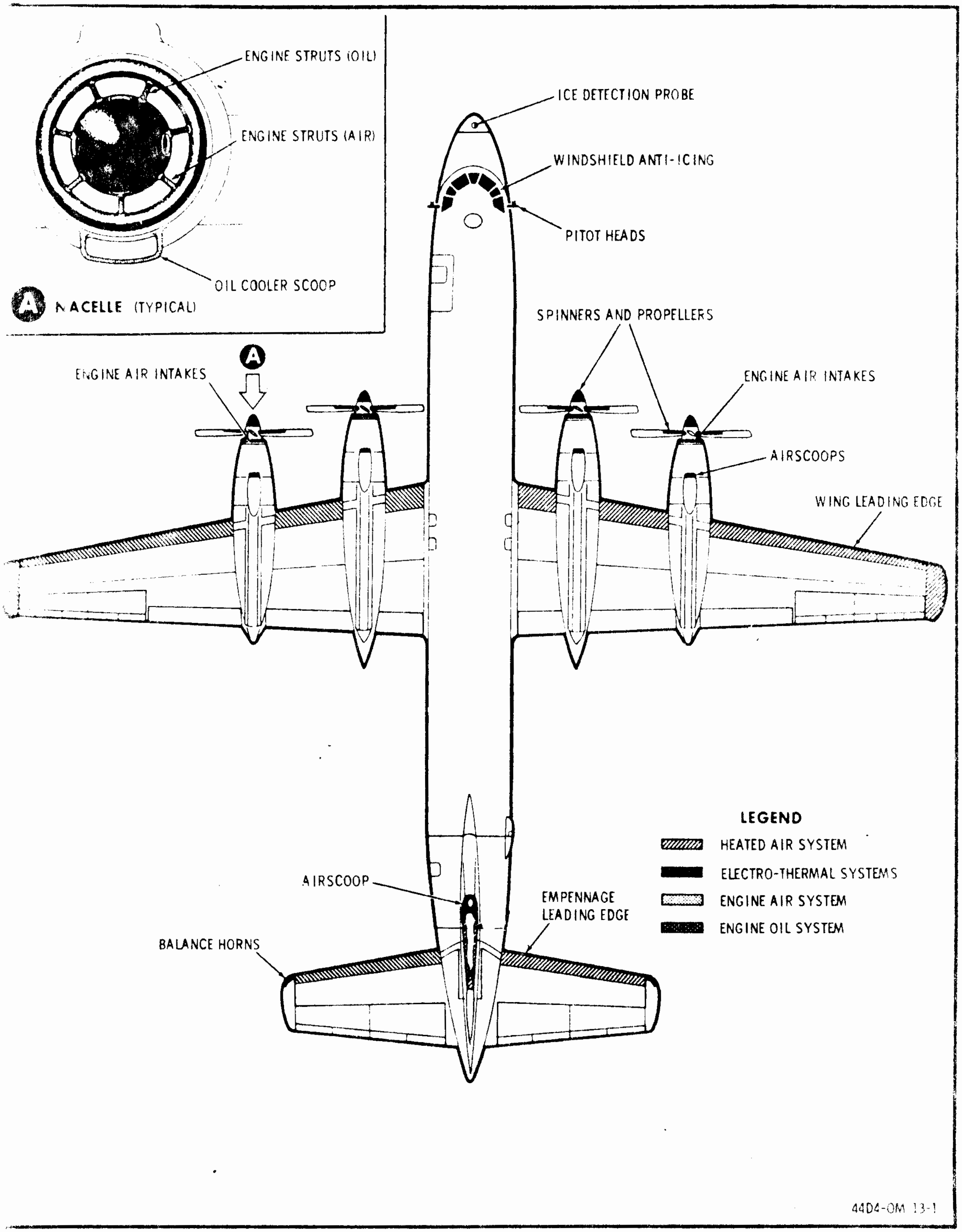
(4) Thermal systems for the engines utilizing engine bleed air and engine oil.

For an illustration of the main anti-icing and de-icing systems, refer to Figure 1.

Two electrically operated windshield wiper systems are also provided.

All anti-icing systems are automatically controlled to maintain sufficient heat to prevent a build-up of ice. A manual override is provided for the wing and empennage hot air thermal systems in case the automatic control fails. All ice and rain protection systems with the exception of windshield heat, pitot heat and windshield wipers are controlled by the systems operator. Windshield heat, pitot heat and windshield wipers are controlled by the pilots. For an illustration of the systems operators anti-icing panel, refer to Figure 4.

To provide immediate optimum protection, all systems controlled by the systems operator, with the exception of the rudder jack box systems, are master controlled. On receipt of an ice warning, the actuation of the ice protection master switch will initiate the appropriate systems provided the system controls are in their normal positions.



Ice and Rain Protection
Figure 1

TEMPORARY REVISION NO. 13-10 (ISSUE 1)

(This TR cancels and supersedes TR 13-10 dated 8 Jul 65)

Insert in Section 13, facing Page 3 dated 26 May 64

ICE AND RAIN PROTECTION

REASON FOR ISSUE

Deletion of automatic initiation of propeller and cowl de-icing.

ACTION

1 - Revise 1.A.(4) last paragraph (on page 3) to read as follows:

An ice detector is installed. When icing conditions are encountered, the system provides an illuminated warning. Safety devices are installed within the systems to prevent overheating of the structure or heating elements.

2 - Revise Paragraph 2 to read as follows:

2. Ice Protection Master Control

The ice protection master control system consists of a switch and seven relays which control the following de-icing circuits: nacelle scoops, empennage anti-icing, propeller and spinner, engine intakes, wing anti-icing, fin airscoop anti-icing, engine guide vane, and elevator horn. All circuits with the exception of the propeller and cowl de-icing are automatically actuated by placing the ice protection master switch located at the systems operators panel, into ON position. With the switch in ON position, the relays are de-energized and control the anti-icing system as follows:

(1) Connect power to each nacelle scoop anti-icing control circuit.
(2) Connect power to the vertical and horizontal stabilizer anti-icing control circuit.
(3) Connect power to each engine intake, and propeller and anti-icing control circuit for indication purposes only (manually controlled for de-icing).
(4) Cause the gate valve actuator for each engine guide vane to open.
(5) Connect the LH and RH relay control power for the elevator horn anti-icing.
(6) Connect power to the fin scoop anti-icing control circuit.
(7) Open the exhaust flap actuators for nacelles 1 and 4, opens each nacelle anti-ice modulating valve, and closes each spill valve in the wing anti-icing circuit.

An ice detector system is installed. When icing conditions are encountered, the system provides an illuminated warning and automatically starts operation of the nacelle scoop, propeller, spinner and engine intake systems, by-passing the master control. Safety devices are installed within the systems to prevent overheating of the structure or heating elements.

2. Ice Protection Master Control

The ice protection master control consists of an ice protection master switch controlling five relays. These relays control the anti-icing circuits of the wings, empennage heaters, propellers and spinners, nacelle scoops, fin scoop, elevator horns and controlling gate valves for the engine guide vane anti-icing. By switching to the ON position in flight, each associated anti-icing system will start immediate automatic operation, provided the individual system control switches are in the NORMAL position.

The relays are energized when the ice protection master switch is placed OFF and de-energized when the switch is placed ON. Power for the ice protection master control is obtained from the 28-volt d.c. main bus.

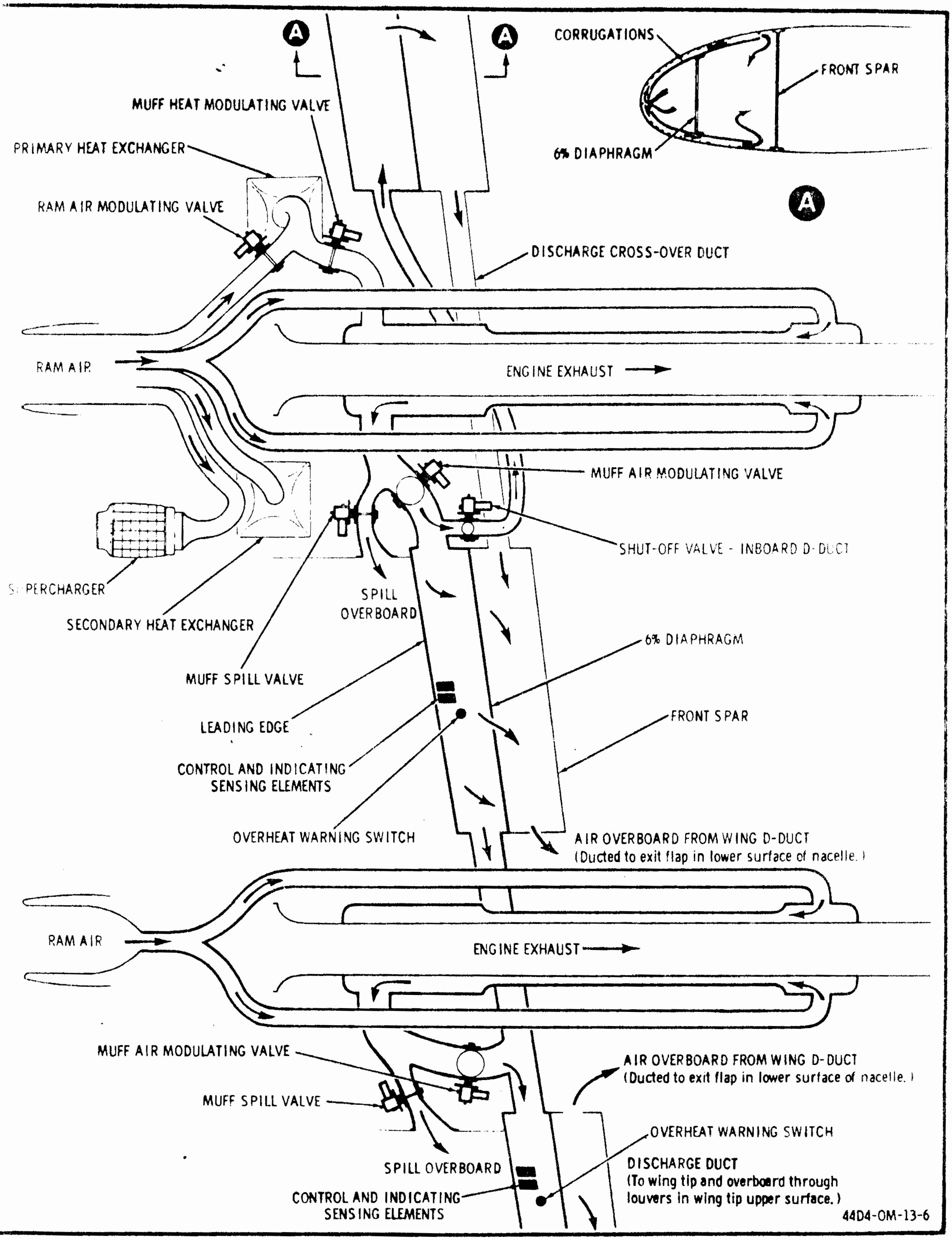
3. Wings Anti-icing System

Thermal anti-icing facilites for the wings are provided by passing hot air, heated by the engine jet pipes, through D-ducts in the leading edges of each wing. Wing skin temperature is maintained by automatic temperature control units. The control units regulate flow valves which govern the amount of hot air to the leading edges. Manual override control is provided in the event of failure of the automatic control. Each inboard and outboard mainplane has its own hot air and temperature control systems. The mainplane systems are similar and independent of each other. For a schematic and diagram of the wing anti-icing system, refer to Figures 2 and 3.

A. Mainplane System Operation

Cold ram air from the nacelle upper intake is passed through the jet-pipe muff where it is heated and passed through an eight-inch duct to the wing leading edges. The inner nacelle jet-pipe muff supplies hot air to the internacelle D-ducts, the outboard leading edge, the primary heat exchanger of the air conditioning system and, through a cross-over duct and shut-off valve, to the D-ducts in the wing leading edge inboard of the inner nacelle. The outer nacelle jet-pipe muff supplies hot air to the leading edges outboard of the nacelles.

The D-ducts are formed by the 6% chord diaphragm and the leading edge. The leading edge panels are constructed of two layers of metal, the inner layer being corrugated. Slots in the inner layer permit the hot air from the D-duct to enter and circulate through the small passages formed by


A
A
CORRUGATIONS
FRONT SPAR
6% DIAPHRAGM
A
MUFF HEAT MODULATING VALVE
PRIMARY HEAT EXCHANGER
RAM AIR MODULATING VALVE
DISCHARGE CROSS-OVER DUCT
RAM AIR
ENGINE EXHAUST
MUFF AIR MODULATING VALVE
SHUT-OFF VALVE - INBOARD D-DUCT
SUPERCHARGER
SECONDARY HEAT EXCHANGER
SPILL OVERBOARD
6% DIAPHRAGM
MUFF SPILL VALVE
FRONT SPAR
LEADING EDGE
CONTROL AND INDICATING SENSING ELEMENTS
OVERHEAT WARNING SWITCH
AIR OVERBOARD FROM WING D-DUCT (Ducted to exit flap in lower surface of nacelle.)
RAM AIR
ENGINE EXHAUST
MUFF AIR MODULATING VALVE
AIR OVERBOARD FROM WING D-DUCT (Ducted to exit flap in lower surface of nacelle.)
MUFF SPILL VALVE
OVERHEAT WARNING SWITCH
DISCHARGE DUCT (To wing tip and overboard through louvers in wing tip upper surface.)
SPILL OVERBOARD
CONTROL AND INDICATING SENSING ELEMENTS
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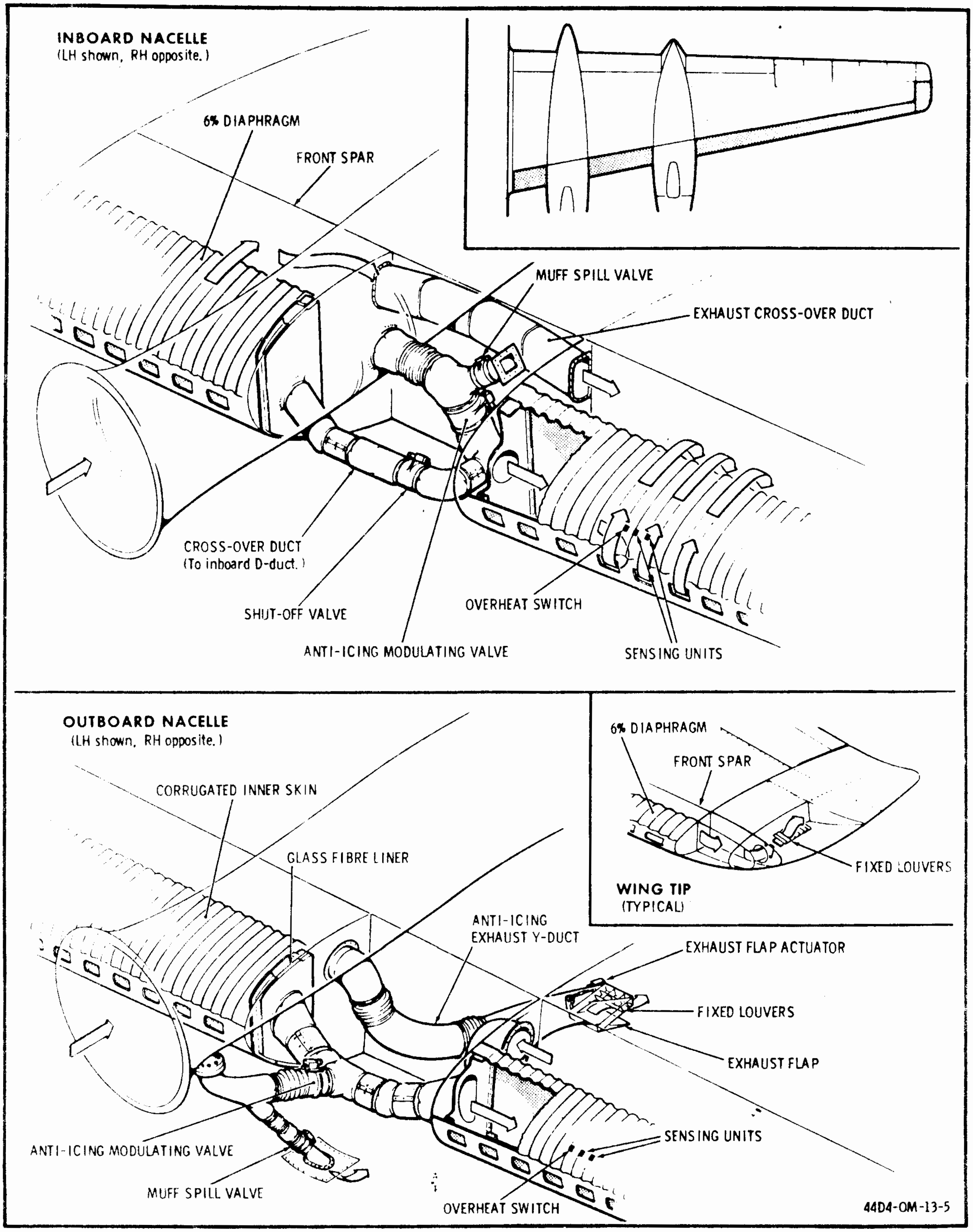
Wing Anti-icing - Schematic
Figure 2



Wing Anti-icing Diagram
Figure 3

the corrugations. The air is exhausted into a duct formed by the 6% diaphagm and the front spar. From this duct a portion of the air is spilled overboard through fixed louvers in the upper surface of the wing tip, and the remainder is ducted to and discharged through electrically operated flaps in the lower surface of the outer nacelles. The exhaust flaps are opened when the ice protection master switch is placed on and are closed when the switch is placed off.

B. Airflow Control Valves

A muff air modulating valve in each eight-inch duct controls anti-icing air. To control the muff air outlet temperature to acceptable levels, a spill duct and muff spill modulating valve are installed upstream of the muff air modulating valve. Under normal flight conditions, either the muff air modulating valve or the muff spill modulating valve is open at all times. When the aircraft is on the ground, the inboard nacelle muff spill valves are closed.

Anti-icing air for the inboard wing section is fed from the inner nacelle by a four-inch cross-over duct downstream from the muff air modulating valve and is controlled by a shut-off valve. The shut-off valve is open at all times except when a condition lever of an engine on the same side is placed to the FEATHER position. If an engine fails, placing the condition lever of the failed engine in the FEATHER position will actuate a microswitch and cause the muff air modulating valve of the failed engine to close, preventing the flow of cold air into the D-ducts. At the same time, the shut-off valve in the cross-over duct to the inboard wing section will close and so cut off anti-icing facilities to the wing section inboard of the inner nacelle. The operating engine on that side will then be able to supply sufficient hot air to anti-ice all the leading edge outboard of the inner nacelle.

C. Temperature Control

Each mainplane temperature control system consists of two temperature control units, two skin temperature sensing elements and two skin overheat thermal switches. A sensing element and an overheat thermal switch, located outboard of each nacelle, sense the inner skin temperature in zones identified as LH outer, LH inner, RH inner and RH outer. The muff air and muff spill valves of each nacelle are controlled by a temperature control unit receiving signals from its associated sensing element.

Each temperature control unit is of the magnetic-amplifier type and incorporates a Wheatstone bridge circuit, a magnetic amplifier, a heat relay and a cool relay. The associated sensing element forms part of the bridge circuit. If the inner skin temperature is at the required value, the bridge circuit will be balanced. Should the temperature rise or fall, the sensing element will unbalance the bridge circuit and an appropriate heat or cool signal will be initiated by the bridge. The signal will be amplified by the magnetic amplifier and the heat or cool relay will be energized to direct d.c. control current to open or close the muff air and muff spill valves.

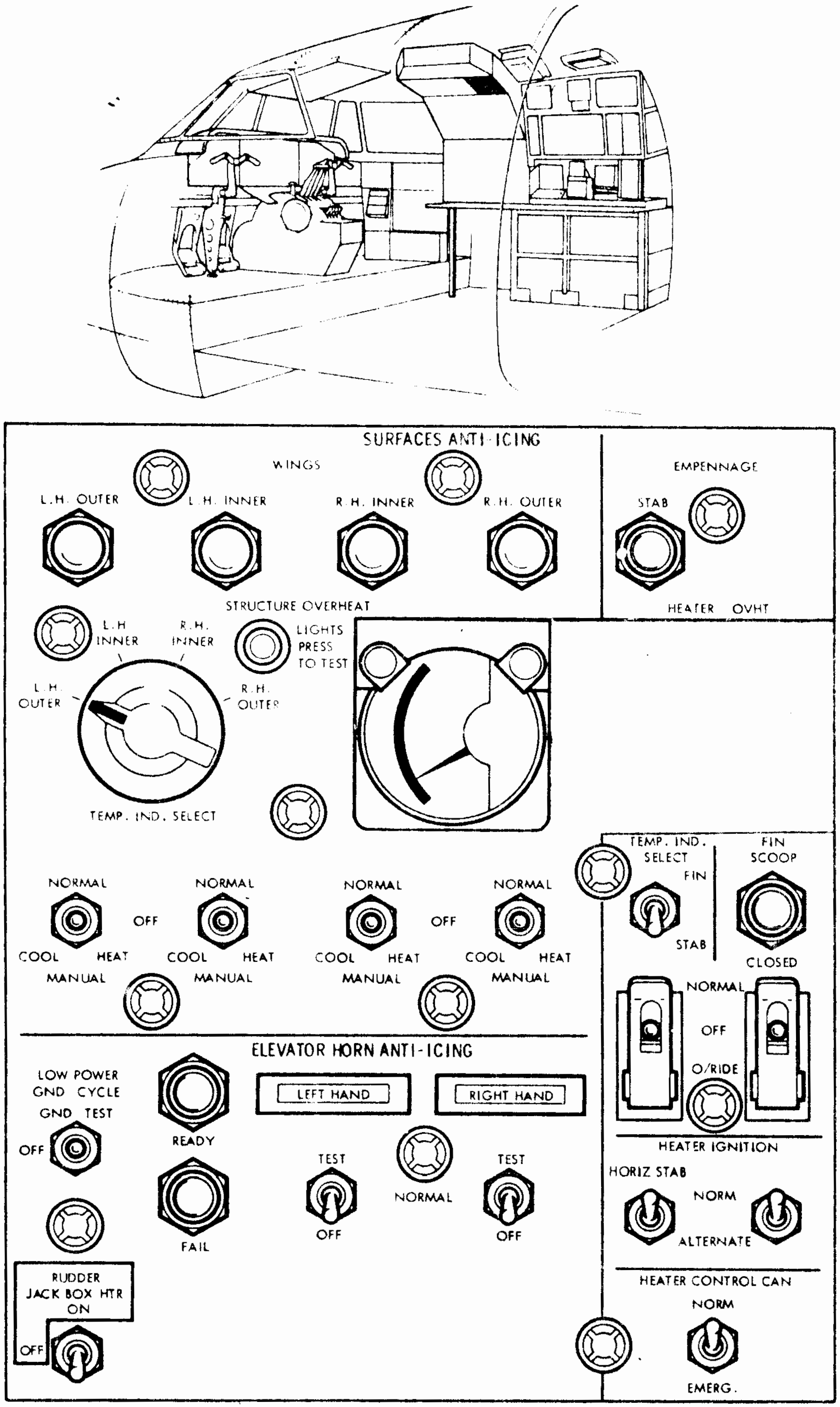
If the control unit receives a heat demand from the sensing element, the muff air modulating valve will open. If there is still a heat demand when the muff air valve reaches the fully open position, the control current will be transferred to the muff spill valve which will then move toward the closed position. A cool demand will cause the muff spill valve to move toward the open position and, when fully open, the control current will be transferred to the muff air valve which will move toward the closed position.

If a temperature control unit fails, the unit may be by-passed by using the MANUAL HEAT or COOL positions of the zone control switch, which will then permit control current to flow direct to the appropriate airflow control valve.

D. Operating Controls and Indicators

The operating controls and indicators of the wings anti-icing system are on the systems operators overhead panel (Ref. Fig. 4). Switching the ice protection master switch to ON will open the outboard nacelle exhaust flaps and permit the system to be operated. Placing the switch to OFF will close the outboard nacelle exhaust flaps and at the same time open all muff spill valves and close all muff air valves. Four zone control switches are each marked NORMAL, OFF, MANUAL COOL, and MANUAL HEAT. When a switch is in the NORMAL position, automatic control is provided through the temperature control unit associated with that particular switch. When a control switch is placed to OFF and the ice protection master switch is ON, the associated temperature control unit will be inoperative and the muff air and muff spill valves will remain in the position reached before the control swich was placed to OFF. The MANUAL COOL and MANUAL HEAT positions provide a manual override feature and, when used in conjunction with the OFF position and the temperature indicator, enable anti-icing operating temperatures to be maintained when the temperature control unit has failed.

The four temperature sensing elements are connected to a four-position rotary temperature indicator selector switch marked LH OUTER, LH INNER, RH INNER, and RH OUTER. When one of the four positions is selected, the temperature in the zone selected is shown on the adjacent indicator. Four structure overheat lights are provided, marked LH



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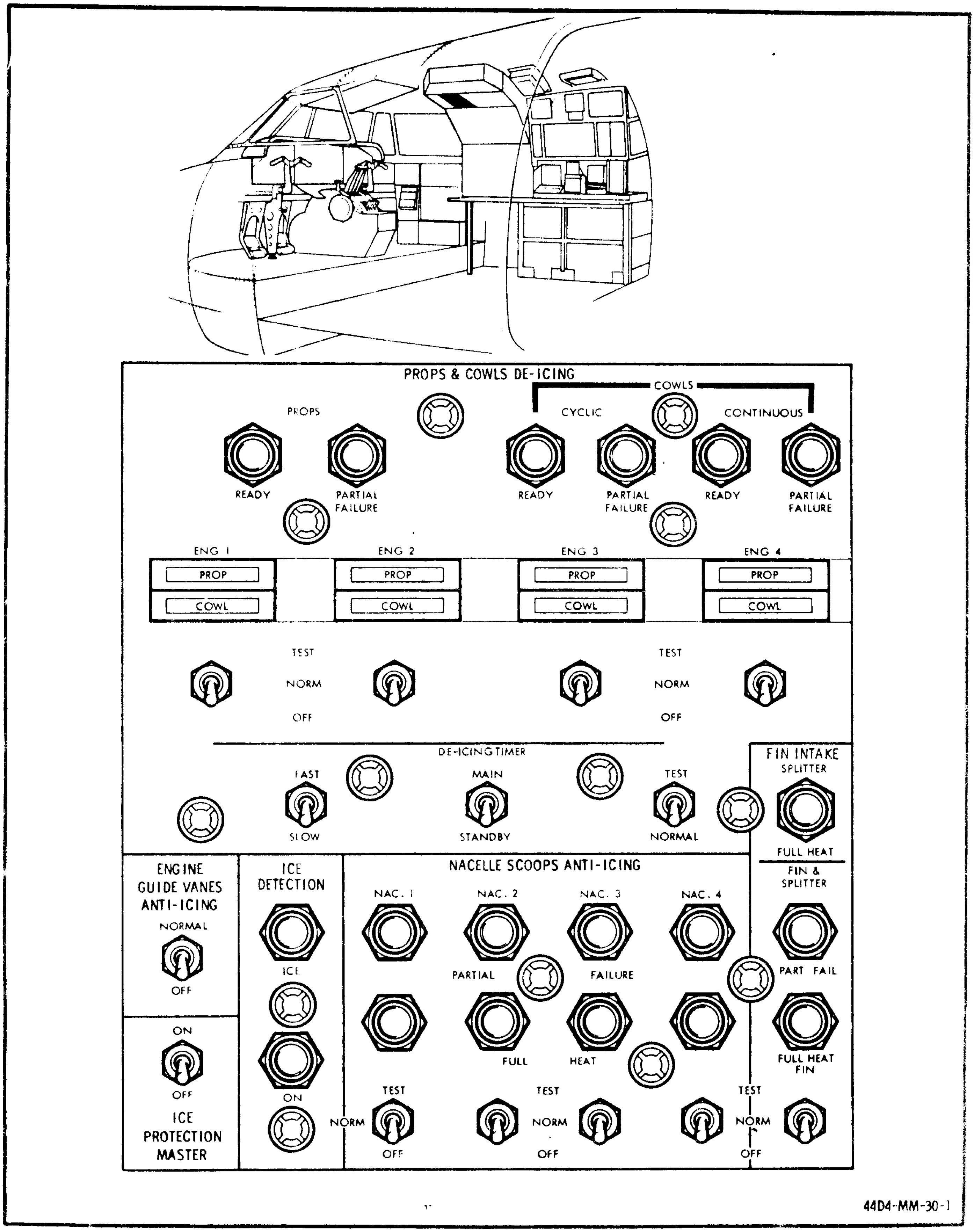
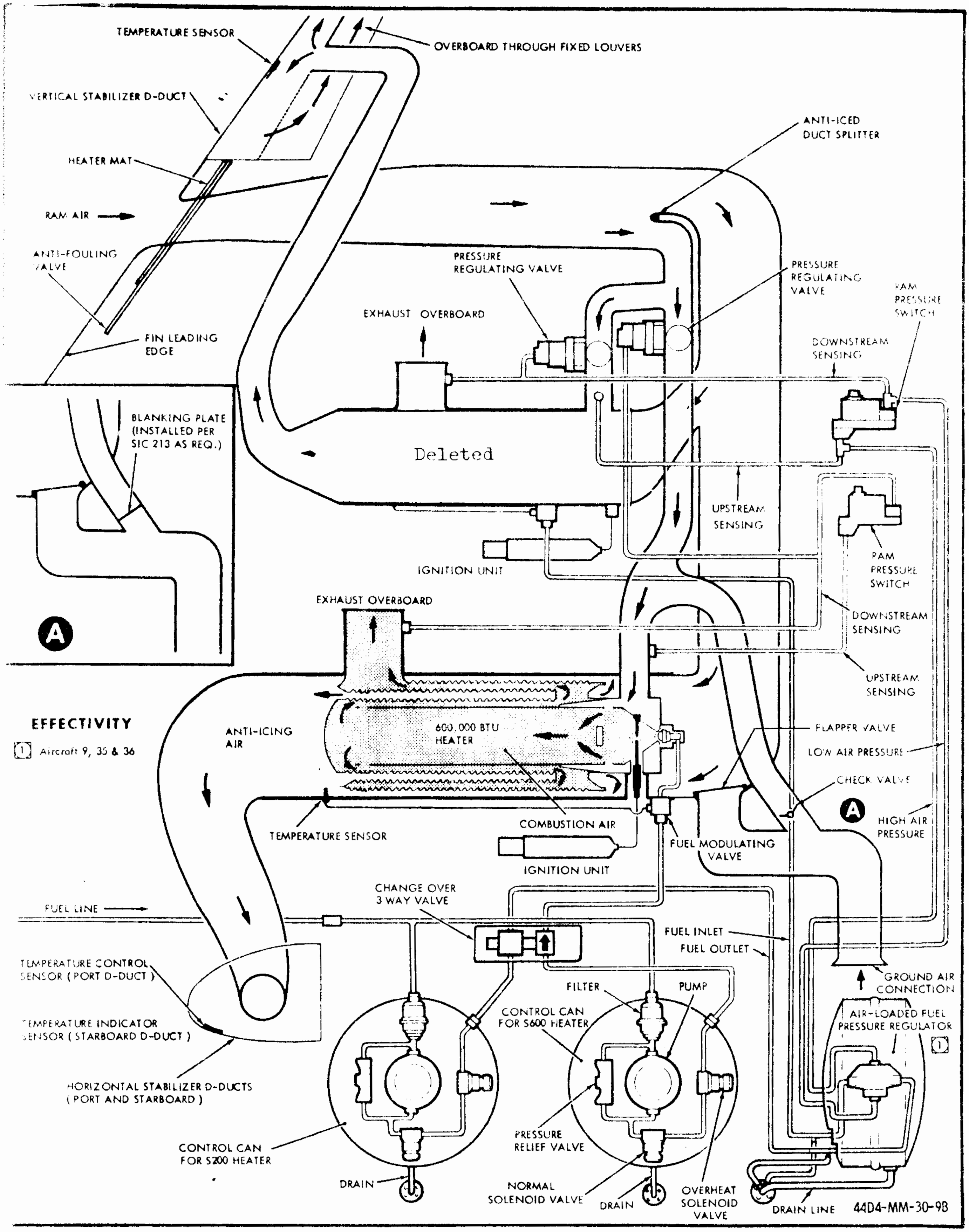
Anti-icing Control Panel - Systems Operators Station
Figure 4 (1 of 2)



Anti-icing Control Panel - Systems Operators Station
Figure 4 (2 of 2)



EFFECTIVITY

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Empennage Anti-icing - Schematic
Figure 5

OUTER, LH INNER, RH INNER, and RH OUTER. If the skin temperature in any zone reaches the setting of the zone overheat thermal switch, the associated overheat light will illuminate. Each light forms part of a push-switch. Each push-switch is of the momentary type and when pushed and held in, will close the associated muff air valve. A LIGHTS PRESS TO TEST button is located below the overheat lights and is used to test the continuity of the circuit.

4. Empennage Anti-icing

The horizontal stabilizer is anti-iced by passing heated air through the leading edge D-ducts. The air is heated by a fuel combustion heater located in the empennage. The 600,000-BTU (S600) heater supplies anti-icing air for the horizontal stabilizer. For a schematic of the empennage anti-icing system, refer to Figure 5. Ram air for the heater is supplied to a main duct from the fin leading edge scoop. An anti-fouling shutter on the scoop is used to prevent the entry of snow, rain and foreign objects while the aircraft is on the ground. The shutter is operated by a handwheel located on the roof centre-line just aft of the swing-tail break. The intake ram air is ducted to the combustion and heat exchanger chambers of both heaters, the exhaust gases being ducted overboard at each side of the aft fuselage.

A ram air switch acts as a heater master switch, preventing the system from operating if there is insufficient ram pressure in the intake ducting. The switch will close when the aircraft speed rises above approximately 87 knots. The switch measures the differential between combustion ram-air pressure upstream of the heater and the lower pressure at the heater exhaust.

After passing through the heater, the heated anti-icing air passes along the D-ducts and circulates about the leading edges in a similar manner to the wing anti-icing system. The anti-icing air is exhausted through fixed louvers in the tips of each stabilizer and fin.

A. Combustion Heaters

The heater consists of a central combustion chamber surrounded by annular heat exchanging ducts enclosed in an outer casing. A pressure sensing air control regulator is installed in the combustion air duct to admit the correct amount of air for efficient combustion. The heater is provided with an ignition unit containing a normal and an alternate vibrator with appropriate switching, either vibrator energizing the heater spark plug.

B. Heater Fuel Control

The heater fuel control system consists of two wing fuel shut-off valves, two fuel control cans and a fuel modulating valve incorporated in each heater. The two wing fuel shut-off valves control the flow of fuel from No. 3 wing tank, via the booster pump, to the heater control cans. The valves open when the control switch is in the NORMAL position, the ice protection master switch is selected ON and sufficient ram pressure is available.

Each control can incorporates a fuel filter, a fuel pump with associated pressure relief valve, a normal fuel shut-off (solenoid) valve and an overheat fuel shut-off (solenoid) valve. The normal fuel shut-off valve permits fuel flow to the heater in response to signals from the temperature control unit and the overheat fuel shut-off valve will cut off fuel flow when the heater overheat thermal switch operates.

The fuel modulating valve functions to maintain the temperature of the heater output air by varying the fuel flow to the heater combustion chamber in response to signals from the temperature sensing capillary tube located in the heater outlet airstream.

Fuel flow from an alternate control can may be diverted to feed to S600 heater should a malfunction occur in the S600 control can. A change-over solenoid valve connects the fuel lines downstream of each control can. When the heater control can switch on the systems operators panel is placed to EMERG, the change-over valve is energized to divert the fuel flow.

C. Temperature Control System

The heater has its own magnetic-amplifier type temperature control unit which operates on an electrical bridge principle, a skin sensor forming part of the bridge. The resistance of the sensor varies with skin temperature, the variation in resistance affecting the balance of the bridge circuit. The resulting signal is amplified and controls the operation of the normal fuel shut-off valve in the control can. An overheat condition would be sensed by the overheat switch at the heater outlet. When the switch opens, the fuel pump and the ignition unit will be de-energized, the overheat fuel shut-off valve in the control can will close, and the overheat light on the systems operators panel will illuminate.

D. Operating Control and Indicators

The operating controls and indicators for the system are located on the systems operators anti-icing panel (Ref. Fig. 4). The ice protection master switch must be switched on before the system can be operated. The heater control switch marked NORMAL, OFF and

CANADAIR

operating manual

TEMPORARY REVISION NO. 13-9

Insert in Section 13, facing Page 13 dated 26 May 64

ICE AND RAIN PROTECTION

REASON FOR ISSUE

Deletion of automatic initiation of propeller and cowl de-icing.

ACTION

Revise paragraph 5. Ice Detection Installation to read as follows:

5. Ice Detection Installation

When the aircraft encounters icing conditions in flight, the ice detection installation provides the pilots and systems operator with a visual warning through the master warning system.

O/RIDE, control the heater. In the NORMAL position, the heater will operate under automatic temperature control. Placing the switch to OFF will break the heater circuit, thus closing the normal and overheat fuel shut-off valves in the control can and de-energizing the ignition unit and fuel pump. When a switch is in the O/RIDE position, the appropriate ignition unit, control can fuel shut-off valves and fuel pump are energized but the temperature control unit is by-passed. An ignition switch below each control switch enables an alternate vibrator to be selected should the normal vibrator fail. The heater control can switch is marked NORMAL-EMERG. Placing the switch to EMERG operates the change-over solenoid fuel valve and disconnects power to the S600 control can. The FIN SCOOP CLOSED light, mounted above the fin heater control switch, illuminates when the fin scoop shutter is in any position other than fully open. A similar warning light, adjacent to the shutter handwheel, operates in an identical manner.

The temperature indicator is used in conjunction with the adjacent TEMP IND SELECT switch to register the skin temperatures of the horizontal stabilizers. A warning light mounted above the temperature indicator, will provide an overheat warning of the stabilizer heater. Opening of a heater overheat thermal switch will illuminate the related light and shut off fuel and ignition to that heater. When the temperature has fallen to a satisfactory level, the switch closes, extinguishing the overheat light and permitting the heater to start operation.

E. Fire Protection

Fire detection for the empennage heater is provided by six thermal switches. Actuation of any one switch will close the two wing tank fuel shut-off valves, de-energize both ignition units, and disconnect power to each control can, closing the overheat and normal fuel shut-off valves and de-energizing the fuel pumps. A fire warning is simultaneously passed to the master warning system. For a more comprehensive description of the empennage fire detection and extinguishing systems, refer to Section 10.

5. Ice Detection Installation

When the aircraft encounters icing conditions in flight, the ice detection installation provides the pilots and systems operator with a visual warning through the master warning system, and simultaneously initiates anti-icing of the nacelle scoops, propellers, spinners and engine cowl mats, by-passing the ice protection master control.

The installation consists essentially of an ice detector probe, an interpreter unit, a green indicator light and a red warning light. The probe protrudes from the underside of the aircraft nose section, forward of the nose wheel well. The interpreter unit is located at the base of the probe within the structure. The red and green indicator lights are located on the systems operators overhead panel.

A. Operation

At aircraft speeds greater than 50 knots, dynamic air pressure entering the perforated ice probe actuates a pressure switch in the interpreter unit. Actuation of this switch illuminates the systems operators green ICE DETECTION ON light and energizes a locking relay in the interpreter unit, arming the ice warning circuit. The green ICE DETECTION ON light will remain on at all speeds above 50 knots, indicating that the system is serviceable and ready to present an icing warning.

When ice forms on the perforated probe, the holes will be covered and a decreased pressure on the pressure switch will result, causing the switch to energize the probe heater relay. Energizing of the probe heater relay will illuminate the systems operators red ICE light, the ICE DETECTED windows of the annunciator panels, cause flashing of the red master warning lights, energize the probe heater circuit and simultaneously initiate anti-icing of the nacelle scoops, propellers, spinners and engine cowls, by-passing the ice protection master control.

On receiving an ice warning, the ice protection master switch will be placed to ON. This action will extinguish the annunciator ICE DETECTED windows and the red master warning lights but the systems operators red ICE warning light will remain illuminated. The probe heater, being energized, will melt the accumulated ice and permit air pressure to re-enter the probe, returning the pressure switch to the armed position and so de-energizing the probe heater circuit and extinguishing the red ICE light. As ice again builds up on the probe, the cycle will be repeated. When icing conditions cease, the red ICE light will stop cycling and remain extinguished. The annunciator ICE DETECTED lights and the red master warning lights are rearmed when the ice protection master switch is placed to OFF.

A thermal switch is incorporated in the ice detector unit to prevent overheating of the probe. The interpreter case interior is also temperature controlled by a heating element circuit which cycles current at temperatures between 13° and 24°C (55° and 75°F).

TEMPORARY REVISION NO. 13-8

Insert in Section 13, facing Page 14 dated 26 May 64

ICE AND RAIN PROTECTION

REASON FOR ISSUE

Deletion of automatic initiation of propeller and cowl de-icing.

ACTION

Revise second paragraph of 5.A. Operation to read as follows:

> When ice forms on the perforated probe, the holes will be covered and a decreased pressure on the pressure switch will result, causing the switch to energize the probe heater relay. Energizing of the probe heater relay will illuminate the systems operators red ICE light, the ICE DETECTED windows of the annunciator panels, cause flashing of the red master warning lights and energize the probe heater circuit.

6. Electrothermal Anti-icing Systems

A. Propeller, Spinner and Cowl De-icing

The propellers, spinners and cowls are de-iced by heating mats energized by variable-frequency three-phase power. Each engine is de-iced by three systems, two of which are cycling (propellers and spinner, cowl shedding area) and one continuous (cowl parting strip). The three systems for each engine are together controlled by a control switch marked OFF, NORMAL, and TEST. Power is fed, through the ice protection master switch or the ice detector unit, to the mats of an engine when the control switch is at NORMAL and the related power lever is above the flight idle position.

When the systems are in operation, a pair of green cycling window lights for each engine, marked PROP and COWL, illuminate as power is applied to the cyclic systems of the engine. The three systems each have one green READY light and one amber PARTIAL FAILURE light. When a control switch is placed to TEST, the three green READY lights will illuminate and the PROP and COWL windows will cycle denoting circuit continuity. The illumination of an amber PARTIAL FAILURE light will indicate the failure of one or two phases of the power supply to that particular system. However, the system can still be operated. In the control switch OFF position, power is disconnected from the circuits of the related engine.

The cyclic power to the propellers, spinners and cowl shedding areas is controlled by a timer control unit. Two units are installed and either may be selected by the timer selector switch which is marked MAIN-STANDBY. A choice of two cycling speeds is provided by a switch marked FAST and SLOW. In the FAST position, used for ambient temperatures above -8°C, the engines sequentially receive power for 20 seconds and then power shuts off for 60 seconds. In the SLOW setting, used for ambient temperatures below -8°C, power is on for 60 seconds and off for 180 seconds. The timer cycles the propellers, spinners and cowl shedding mats in the following sequence:

(1) No. 1 position - No. 1 propellers and spinner and No. 1 and 3 cowl shedding mats.

(2) No. 2 position - No. 2 propellers and spinner and No. 2 and 4 cowl shedding mats.

(3) No. 3 position - No. 3 propellers and spinner.

(4) No. 4 position - No. 4 propellers and spinner.

The timer automatically resets to No. 1 position when the system is off so that when power is reapplied, a new cycle is started. The timer TEST-NORMAL switch enables the timer unit to be checked. When the switch is placed to TEST, the window lights cycle but no power is applied to the heating mats.

B. Nacelle Scoop Anti-icing

The nacelle scoop of each engine is fitted with electrical anti-ice mats energized by variable-frequency three-phase power. The heated areas of each inner nacelle scoop are the nose piece, the three vertical splitters and the first bend in the main intake duct. The heated areas of each outer nacelle scoop are the nose piece, two vertical splitters and one horizontal splitter.

A TEST-NORMAL-OFF control switch, a PARTIAL FAILURE warning light and FULL HEAT light are provided for each nacelle scoop, the FULL HEAT light illuminating when the mats are energized. To prevent damage to the heater mats, the circuits are deactivated by a ground safety switch when the aircraft is on the ground. By placing the control switch to TEST, the ground safety switch is by-passed for the appropriate engine and the respective FULL HEAT light illuminates. With the control switch in the NORMAL position, 28-volt d.c. energizes the nacelle scoop power relay through the ice protection master control, the ground safety relay and three thermal switches. The variable-frequency supply is connected to the heater elements through the power relay. The thermal switches cycle the heaters by making and breaking the power relay coil circuits. With the control switch in the OFF position, power is disconnected from the system. Failure of one or two phases of the power supply to a nacelle scoop is indicated by the illumination of the associated PARTIAL FAILURE light. The system may still be operated under these conditions.

C. Fin Air Intake Scoop Anti-icing

The heating mats on the tail fin air intake scoop and on the scoop splitter operate in a similar manner to the nacelle scoop mats. A TEST-NORMAL-OFF control switch controls the circuit which incorporates an amber PART FAIL light for the intake and splitter, a FULL HEAT FIN light for the intake and a FULL HEAT light for the splitter. A safety cut-out relay breaks the circuit when the aircraft is on the ground. The TEST position of the control switch by-passes the safety relay and illuminates both FULL HEAT lights. The amber PART FAIL light illuminates when there is a failure of one or two phases of the power supply. The mats are cycled by a thermoswitch, an overheat thermoswitch also being installed. The circuit is master controlled by the ice protection master switch.

D. Elevator Horn Anti-icing

Anti-icing of the elevator horns is accomplished by heating mats energized by variable-frequency three-phase power. Each elevator horn has its own control unit and circuit. The control units are of the magnetic-amplifier type and are set to maintain horn balance temperatures between 55°C and 60°C. Each control unit incorporates a fail safe circuit which ensures that the horn balance heating elements remain energized if automatic control system fails. Power to the mats is fed through the ice protection master relay and the ground safety relay.

The controls and indicators for the system consist of two control switches, two power on window lights, a green READY light, an amber FAIL light and a low power ground cycle switch. Each control switch is marked TEST-NORMAL-OFF and has a power on window light mounted above it. When a control switch is in the NORMAL position, the applicable window illuminates, indicating that power is on the heaters of that side. The green READY light illuminates when either control switch is selected to TEST but remains extinguished during normal operation The FAIL indicator light illuminates when a phase failure occurs in the power supply. The system may be operated under this condition.

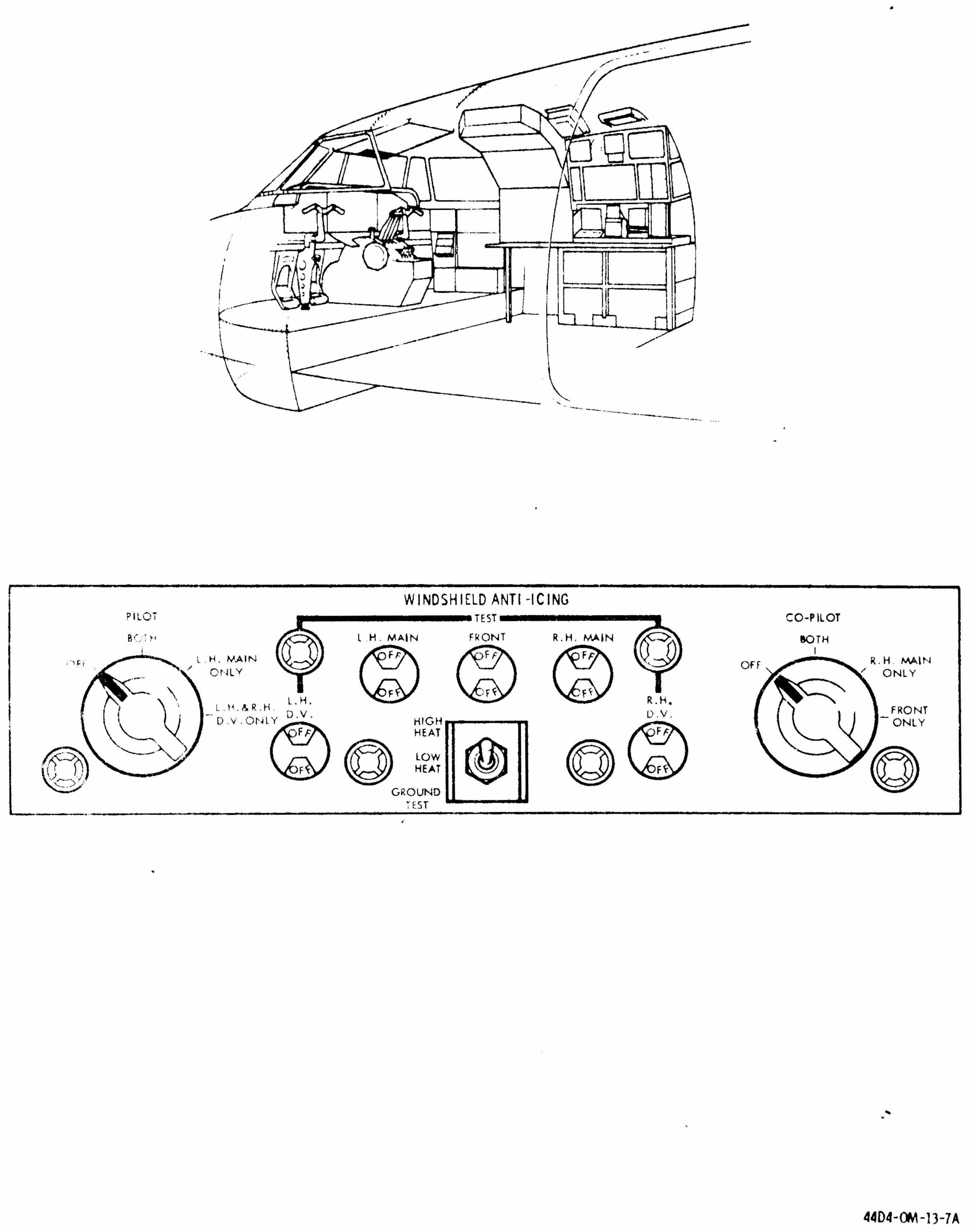
To permit the system to be tested on the ground, a low power ground cycle switch is provided. Placing the switch to GRD TEST by-passes the ground safety relay, applies a low voltage to cycle the mats and illuminate the power on windows.

E. Windshield Anti-icing

The windshield is composed of seven NESA glass panels designated, clockwise from the port side, as follows; LH side, LH DV (direct vision), LH main, front, RH main, RH DV, RH side. The LH and RH side windows are demisted only and the remainder are anti-iced.

Temperature sensors, magnetic amplifier control units and control relays operate in conjunction with each other to supply high or low voltages to maintain a nominal windshield temperature of 38°C. A failure of a sensor automatically disconnects power from the associated windshield. The circuitry is wired through the ground safety relay and is so designed that low voltage heat only is applied to the windshields when the aircraft is on the ground.

The windshield controls and indicators are located on the pilots overhead panel and consist of a pilots control switch, a co-pilots control switch, five flag indicators and a test switch (Ref. Fig. 6). The pilots control switch is marked BOTH, LH MAIN ONLY, LH & RH DV ONLY, and the co-pilots control switch is marked BOTH, RH MAIN ONLY, FRONT ONLY. By



Windshield Anti-icing and Demisting Control Panel
Figure 6

selective positioning of both control switches, it is possible to isolate the power to the front, LH or RH main windows or both DV windows. The five flag indicators, one representing each of the five forward windows, indicate by ON or OFF flags whether or not load is applied to the windshields.

The heat selector switch is a three-position switch marked HIGH HEAT, LOW HEAT and GROUND TEST. The GROUND TEST position permits testing of the high voltage heat elements while the aircraft is on the ground. To ground test the windshields, the control switches are placed to BOTH and the heat selector switch held in the GROUND TEST position only until the flag indicators show ON flags. Care should be exercised that the windshields are not overheated when being tested. The HIGH HEAT position is selected when ambient temperatures are below -5° C and LOW HEAT when ambient temperatures are above -5° C.

The LH and RH side windows are automatically demisted when either of the control switches is placed to any position other than OFF. Thermal sensing elements maintain a heat of 37.8°C. The windshield anti-icing system is not controlled by the ice protection master switch. To maintain impact strength, windshield heat must be on during all take-off and flight conditions.

F. Pitot Tube Anti-icing

The two pairs of pitot tubes are anti-iced by integral electrically heated elements energized by 28-volt single-phase constant-frequency a.c. power. The power supply is controlled by a pitot tube ON-OFF switch located on the pilots overhead panel.

Three loadmeters, located adjacent to the pitot tube switch, are operated through current transformers when the pitot tube heater power supply circuits are energized. The loadmeters are marked PILOT, ART FEEL, CO-PILOT and indicate the load on the port outer tube, the two inboard tubes and the starboard outer tube respectively. In addition, each pitot tube has a warning system which alerts the pilot when pitot heat has failed. Pitot tube heat is not master controlled by the ice protection master switch.

G. Drain Anti-icing

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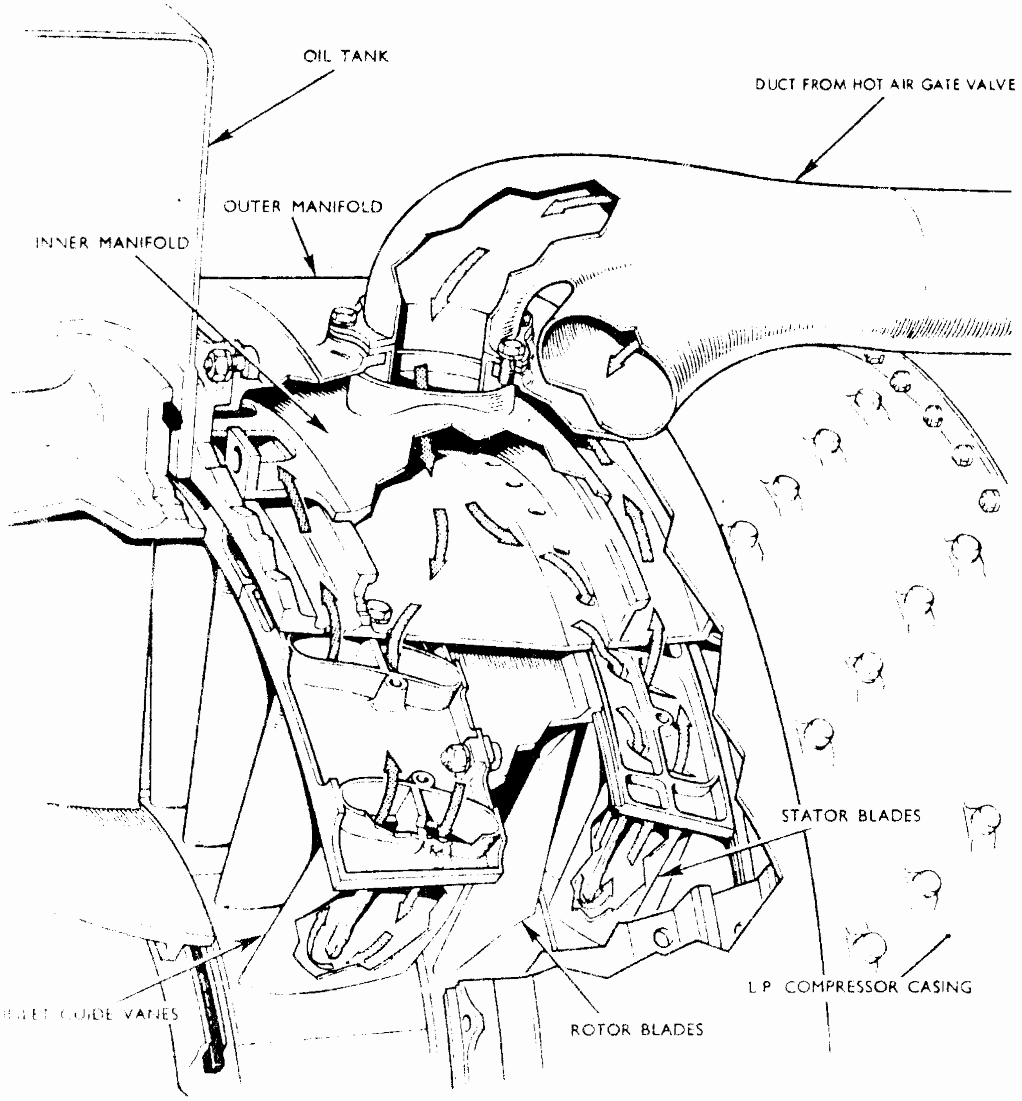


Inlet Guide Vane and Stator Blade Anti-icing Air Flow
Figure 7

H. Rudder Jack Box Anti-icing

A heater jacket, covering the entire rudder jack box, is provided to prevent or overcome jamming of rudder controls caused by freezing of moisture in jack box. The heater operation is controlled by two thermal switches, mounted on the heater jacket, which control the heater elements on demand, and by a master switch, marked ON-OFF, located on the systems operators anti-icing control panel.

7. Engine Anti-icing

A. Engine Anti-icing (Air)

To prevent the formation of ice in each engine when operating in low temperatures, an electrically controlled anti-icing system uses hot air, tapped from the final stage of the HP compressor to heat the LP compressor inlet guide vanes and first stage stator blades (Ref. Fig. 7). Hot air from the same source is also used to heat the three lower struts of the air intake casing and the lips of the oil cooler inlet duct. An electrically actuated gate valve controls the hot air supply.

The gate valves of the four engines are actuated together through an engine guide vanes anti-icing switch on the systems operators overhead panel. The switch is marked NORMAL and OFF and is master controlled by the ice protection master switch. When the ice protection master switch or the engine guide vanes switch is in the OFF position, the gate valves are closed. When the engine guide vanes switch is in NORMAL and the ice protection master switch is ON, the valves are controlled by microswitches operated by their respective engine power levers. Below 72% (11,000) LP rpm, the gate valve is fully open. Should the engine power levers be set to give an engine speed of over 75% (11,500) LP rpm, the valve is repositioned to admit a lesser amount of air for anti-icing. The master caution lights and the four ENGINE BLEED windows on each annunciator panel illuminate whenever air is being bled from the engines, thereby warning the pilots that for any particular power lever setting there will be a reduction in the normal power output.

B. Engine Anti-icing (Oil)

The upper four intake struts are heated by return oil which passes through the struts prior to being delivered through the cooler to the tank, the heat of the oil in the tank helping to prevent ice formation in the intake casing.

8. Rain Protection

A. Windshield Wipers

Windshield wipers are provided for the LH and RH main windshield panels, each wiper being operated by its own 1/5-hp electric motor. Each motor is controlled independently by its respective switch on the pilots or co-pilots side panel. The four positions of each switch are PARK, OFF, FAST, and SLOW. The PARK position is spring loaded to the OFF position. In the SLOW position, the wiper blades operate at between 135 and 145 strokes per minute and in the FAST position, operate at between 265 and 275 strokes per minute. Use of the wiper blades over dry glass should be avoided.

The pilots wiper motor is powered from the constant-frequency a.c. bus A and the co-pilots from constant-frequency a.c. bus B.

9. Power Sources

The circuit-breakers and power sources for the ice and rain protection systems are as follows:

(1) Constant-frequency Bus Panel A	Quantity
Pilots Windshield - Windshield Wiper	3
Pilots Windshield - A/I Control - LH Main	1
Pilots Windshield - A/I Control - LH & RH DV	1
Pilots Windshield - A/I Power - LH Main	2
Pilots Windshield - A/I Power - LH DV & RH DV	4
Tail A/I Control - Horizontal Stabilizer	1
Tail A/I Control - Vertical Fin	1
A/I Timer Standby	1
Pitot Tube Heater - Pilot	1
Deleted	
(2) Constant-frequency Bus Panel B	
Co-pilots Windshield - Windshield Wiper	3
Co-pilots Windshield - A/I Control - RH Main	1
Co-pilots Windshield - A/I Control - Front	1
Co-pilots Windshield - A/I Power - RH Main	2
Co-pilots Windshield - A/I Power - Front	2
Co-pilots Windshield - A/I Power - Demist	2
Elev Horn - Anti-ice Control LH and RH	2
A/I Timer Main	1
Pitot Tube Heaters - Co-pilot	1
Pitot Tube Heaters - Artificial Feel LH and RH	2
Rudder Jack Box Heater	1

	Wing Anti-ice Controls - LH Outbd and Inbd	2
	Wing Anti-ice Controls - RH Outbd and Inbd	2
(3)	D.C. Main Bus Panel	
	Temp Indicators - Skin Temp - Wing and Tail	2
	De-ice Indicator Lights - Props	1
	De-ice Indicator Lights - Cowl Shed Mats	1
	De-ice Indicator Lights - Cowl Parting Strips	1
	Wing A/I Air Cond. Change Over Relay	1
	De-ice Ready Indicator Lights Test	1
	Props and Cowls De-icing - Main Control Nos 1, 2, 3 and 4	4
	Props and Cowls De-icing - Timer Sel. Relay	1
	Props and Cowls De-icing - Test	1
	Props and Cowls De-icing - Standby Control Nos 1, 2, 3 and 4	4
	Engine Guide Vane Anti-icing Nos 1, 2, 3, and 4	4
	Ice protection Master Control	1
	Deleted	
	Windshield A/I Control - A/I Test and De-mist	1
	Windshield A/I Control - Front	1
	Windshield A/I Control - RH Main	1
	Elevator Horn A/I Power Relay Control LH and RH	2
	Elevator Horn A/I Indicator	1
	Fin Scoop A/I - Indicator	1
	Fin Scoop A/I - Control	1

	Fin Scoop A/I - Flap Indicator	1
	Nacelle Scoop A/I - Control Nos 1, 2, 3 and 4	4
	Nacelle Scoop A/I - Indicators Nos 1, 2, 3 and 4	4
	Wing A/I - Mod Valve Emergency Close	1
	Wing A/I - Modulator and Spill Valves LH Inboard and Outboard	2
	Wing A/I - Modulator and Spill Valves RH Inboard and Outboard	2
	Wing A/I - Exhaust Flap Acutator LH and RH	2
	Wing A/I - Control LH and RH	2
(4)	D.C. Essential Bus Panel B	
	Empennage A/I Control - Fuel S/O. Valve No. 1 and No. 2	2
	Empennage A/I Control - Vertical Fin and Horiz Stabilizer	2
	Empennage A/I Control - Ice Detection	1
	Windshield A/I Control - LH and RH DV	1
	Windshield A/I Control - LH Main	1
	Wing A/I Overheat Warning - LH Inboard and Outboard	2
	Wing A/I Overheat Warning - RH Inboard and Outboard	2
(5)	Variable-frequency A.C. Panel	
	Fin Scoop A/I	3
	Elevator Horn A/I LH and RH	6
	Nacelle Scoops A/I Nos 1, 2, 3 and 4	
	Engine Cowl Shedding Mats De-ice Nos 1, 2, 3 and 4	
	Engine Cowl Parting Strips De-ice Nos 1, 2, 3 and 4	
	Propeller and Spinner De-icing Nos 1, 2, 3 and 4 (Limiter Protected)	12

SECTION 14

INSTRUMENTS

1. General

Each pilots instrument panel mounts the following flight and navigation instruments: airspeed indicator, machmeter, altimeter, turn and bank indicator, rate-of-climb indicator, approach horizon, course indicator and radio magnetic indicator (RMI). A magnetic compass is installed above the anti-glare shroud in the windshield vee.

The centre instrument panel mounts the following engine instruments for each engine: torquemeter, low pressure compressor and high pressure compressor tachometers, turbine gas temperature indicator, fuel flow indicator, oil pressure indicator, oil temperature indicator and fuel idling throttle valve position indicator.

Miscellaneous instruments include an auto pilot trim indicator, clocks, free air temperature indicator, flap position indicator and landing gear position indicator on the centre instrument panel, a rudder trim and an aileron trim indicator on the pedestal and five control surface position indicators on the pilots side panel.

In addition to the above engine instruments, two HP turbine oil temperature dual indicators are installed on the lower instrument panel at the systems operators station.

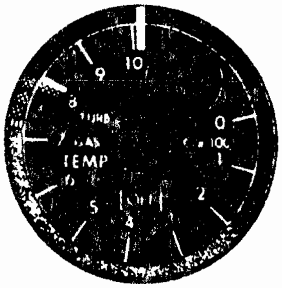
For those flight and engine instruments bearing limitation markings, refer to Figure 1.

2. Flight Instruments

A. Airspeed Indicators

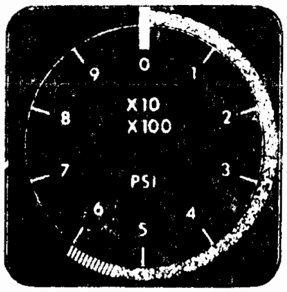
The pilots airspeed indicators are both of the maximum safe airspeed type and are calibrated from 40 to 400 knots. The maximum safe airspeed is indicated by the twin pointer barber pole. An adjusting knob on the indicator is used for setting the twin pointer barber pole. A fixed peripheral arrowhead is preset against the .63 Mach number.

At sea level, the SL pointer indicates the permissible V_{MO}. From sea level to 20,000 feet, the permissible V_{MO} varies linearly between the SL and 20 pointers. For example, at 10,000 feet the permissible V_{MO} is just half-way between the SL and 20 pointers. At 20,000 feet and above, the 20 pointer indicates either the permissible V_{MO} or the air-



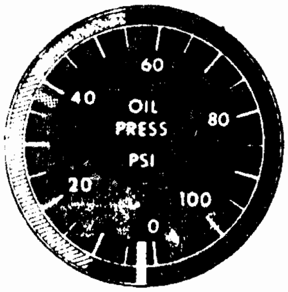
TURBINE GAS TEMPERATURE INDICATOR

CIRCULAR GREEN 200°C TO 715°C
CIRCULAR YELLOW AT 715°C TO 735°C
RED DOTS AT 735°C TO 790°C
RED RADIAL AT 790°C
WHITE RADIAL AT 800°C
WHITE INDEX MARK



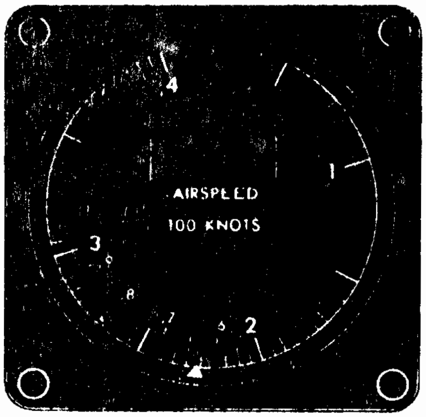
TORQUE PRESSURE INDICATOR

CIRCULAR GREEN 0 PSI TO 532 PSI
CIRCULAR YELLOW 532 PSI TO 600 PSI
WHITE INDEX MARK



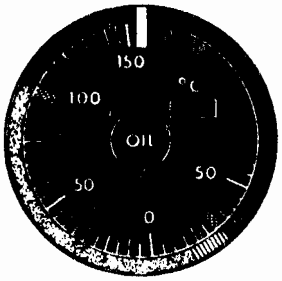
OIL PRESSURE INDICATOR

CIRCULAR YELLOW 10 PSI TO 40 PSI
RED RADIAL AT 38 PSI
CIRCULAR GREEN 40 PSI TO 55 PSI
WHITE INDEX MARK



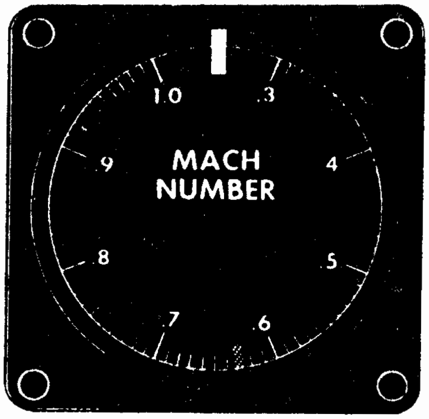
AIRSPEED INDICATOR

ARROW AT .63 MACH



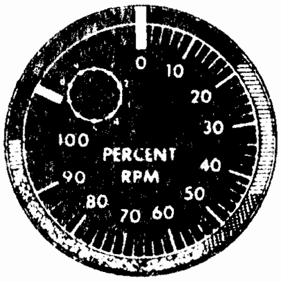
OIL TEMPERATURE INDICATOR

RED RADIAL AT -30°C
CIRCULAR YELLOW AT -30°C TO -15°C
CIRCULAR GREEN AT -15°C TO 100°C
RED RADIAL AT 100°C
WHITE INDEX MARK



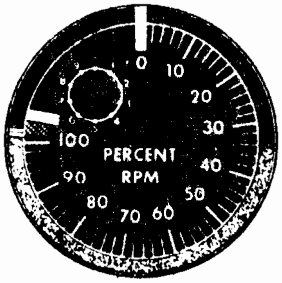
MACHMETER

RED RADIAL AT .63 MACH
WHITE INDEX MARK



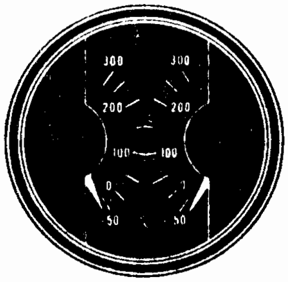
LP COMPRESSOR RPM INDICATOR

CIRCULAR YELLOW 19.6% TO 42.5%
CIRCULAR RED 42.5% TO 55.6%
CIRCULAR GREEN 55.6% TO 95%
CIRCULAR YELLOW 95% TO 100%
RED RADIAL AT 100%
WHITE RADIAL AT 110%
WHITE INDEX MARK



HP COMPRESSOR RPM INDICATOR

CIRCULAR GREEN 34.7% TO 100.9%
CIRCULAR YELLOW 100.9% TO 102%
SHORT RED RADIAL AT 102%
WHITE RADIAL AT 105.5%
WHITE INDEX MARK



HP TURBINE OIL TEMPERATURE INDICATOR

LEGEND ▥ YELLOW ▨ RED ▩ GREEN

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Flight and Engine Instrument Markings
Figure 1

speed corresponding to the permissible M_{MO}, whichever is the lesser. Prior to each take-off, the SL pointer is set to the SL V_{MO} shown for the appropriate zero fuel weight and must not be reset in flight. For V_{MO} speeds at various zero fuel weights, refer to Section 3, Airspeed Limitations.

The airspeed indicator at the navigators station is of the standard type and is calibrated from 50 to 425 knots.

B. Machmeters

The machmeters are of the conventional subsonic type, calibrated from 0.3 to 1.0 mach number. Readings can be made to within .01 mach number and accuracy is between .01 and .02. The instruments will operate at pressure altitudes between 0 and 50,000 feet.

C. Turn and Bank Indicators

Two turn and bank indicators are installed in the aircraft, one each on the pilots and co-pilots instrument panels. Power for the pilots turn and bank indicator is supplied from the constant-frequency a.c. panel A and for the co-pilots turn and bank indicator from constant-frequency a.c. panel B. A warning flag is displayed when power is removed from the instrument.

D. Approach Horizons, Course Indicators and Radio Magnetic Indicators

For a description of the approach horizons, course indicators and radio magnetic indicators, refer to Section 18. Both pilots approach horizons and course indicators are powered from the constant-frequency a.c. bus systems. The pilots RMI is powered by the constant-frequency a.c. and d.c. essential buses, the co-pilots RMI by the constant-frequency a.c. and d.c. main buses.

E. Magnetic Compass

A direct-reading vertically mounted magnetic compass is installed above the anti-glare shroud in the windshield vee. The compass is of the air chamber type with a built-in compensator.

3. Engine Instruments

A. Torquemeter Pressure Indication

A self-synchronous torquemeter pressure indicating system, consisting of a transmitter and an indicator, is provided for each engine. The transmitter is subject to pressure tapped from the oil feed to one of the torquemeter cylinders. Variation in pressure is sensed in the transmitter by a Bourdon tube which alters the angular position of the rotor and so changes the voltage output of the stator windings. The indicator registers the angular position of the transmitter rotor in terms of pounds per square inch. Power is supplied to the system through a circuit-breaker on the constant-frequency a.c. panel at the main distribution panel.

B. LP Compressor and HP Compressor Tachometers

Each engine has two tachometers, an LP compressor tachometer and a HP compressor tachometer. The LP compressor tachometer expresses LP compressor speed as a percentage of 15,280 LP rpm. The HP compressor tachometer expresses HP compressor speed as a percentage of 17,650 HP rpm.

NOTE: The LP take-off rpm reading is 99.8%, equivalent to 15,250 LP rpm.

Engine tachometers are self-generating and do not require power from the aircraft electrical system.

BA. Engine Synchroscope

The synchroscope is electrically connected into the tachometer-generators of all four engines and is used to indicate the difference in speed between the master engine (engine No. 3) and the other three engines. Three small double-ended pointers on the face of the instrument are marked 1, 2 and 4. The direction and speed of the rotation of each pointer indicates the difference in speed between the engine indicated and the master engine. Clockwise rotation of the pointer indicates that the engine is running faster than the master, counter-clockwise indicates it is running slower.

C. Turbine Gas Temperature Indicators

The temperature of the gas entering the turbine of each engine is measured by ten pairs of thermocouples, equally spaced around the periphery of the nozzle box of each engine in line with the low pressure turbine nozzle guide vanes, and is indicated on an indicator for each engine on the centre instrument panel. The indicators are powered by the constant-frequency a.c. system with the circuit-breakers on the main distribution panel. A warning flag is incorporated in each indicator to show power failure.

D. Fuel Flowmeters

For a description of the fuel flowmeters, refer to Section 17. Power for the fuel flow indicating system is obtained from the constant-frequency a.c. system and the d.c. essential bus.

E. Oil Pressure Indicators

Engine oil pressure is measured by a synchro transmitter mounted on the high pressure wheelcase and is presented in pounds per square inch on an indicator for each engine. Power for the indicators is obtained from the constant-frequency a.c. system through circuit-breakers on the main distribution panel.

F. Oil Temperature Indicators

The oil temperature indicating system for each engine consists of an electrical resistance-type bulb installed at the oil pressure pump inlet and an indicator on the lower centre instrument panel. Power for each engine system is supplied from the d.c. essential bus B at the main distribution panel through circuit-breakers, one for each indicator.

Oil temperature at the HP turbine is measured by a thermometer bulb located in the scavenge line immediately downstream of the HP turbine bearing. Dual temperature indicators are mounted on the systems operators lower instrument panel. Power for the system is supplied from the d.c. essential bus through circuit-breakers, one for each indicator.

G. Fuel Idling Throttle Valve Position Indicators

Four fuel idling throttle valve-position indicators, one for each engine, are mounted on the centre instrument panel. Each indicator is of the flag type and displays HIGH when the valve is open, LOW when the valve is closed, and diagonal strips when the valve is in transit or de-energized. The valves and indicators are energized from the d.c. essential bus, panel A.

4. Miscellaneous Instruments

Power sources for the following position indicating instruments are: The wing flap indicator and the landing gear position indicator powered by the d.c. essential bus; the aileron trim and rudder trim indicators powered by the d.c. main bus; the control surface position indicators, consisting of one rudder, two aileron and two elevator indicators all powered through one circuit-breaker on the d.c. main bus.

The free air temperature indicator on the centre instrument panel is powered by the d.c. main bus.

5. Pitot-Static System

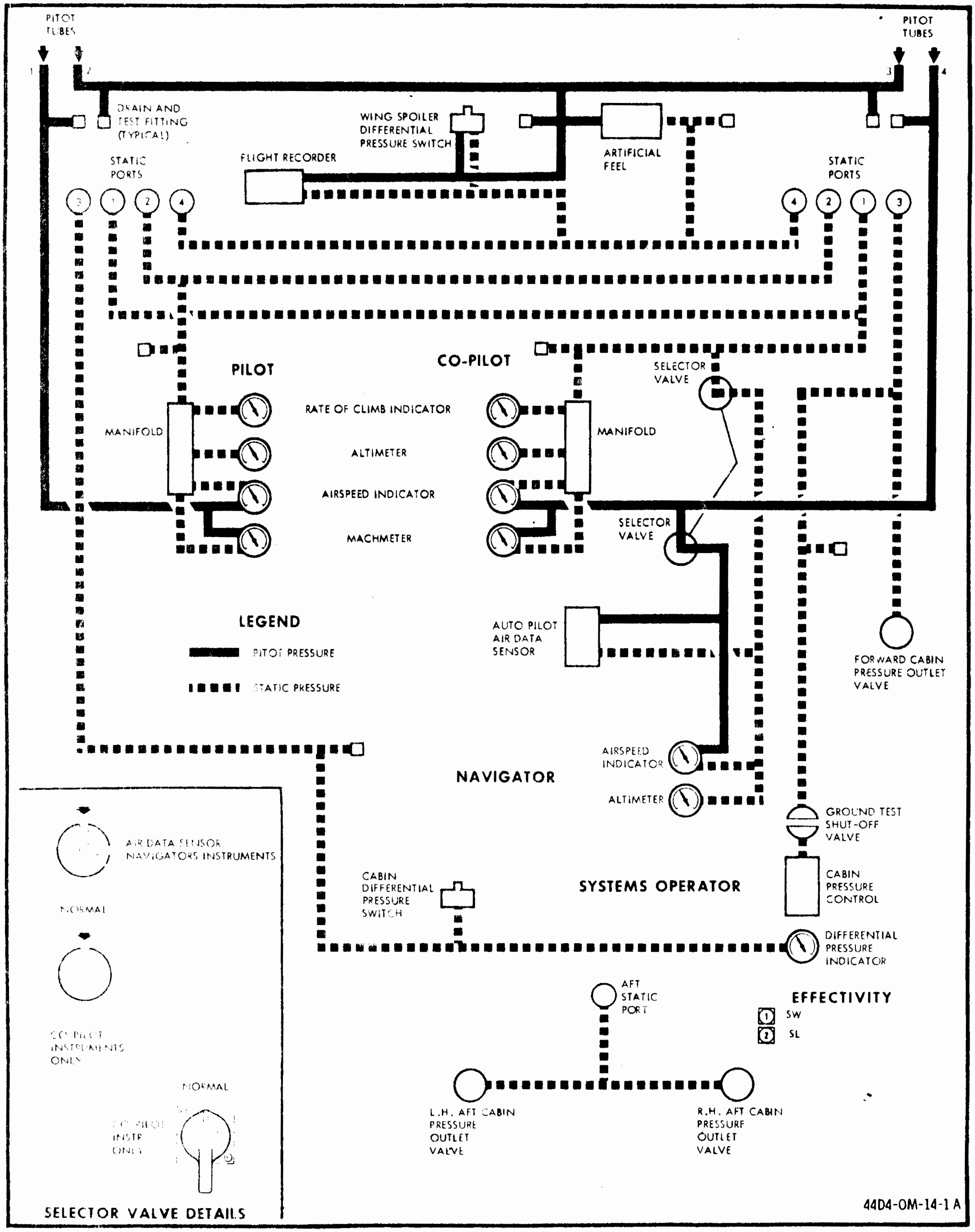
The pitot-static system consists of four electrically heated pressure heads, nine static vents, a selector valve, drain fittings and the necessary lines. For a schematic of the pitot-static system, refer to Figure 2.

The pressure heads are arranged in pairs on each side of the nose. The port outer head supplies dynamic pressure to the pilots airspeed indicator and machmeter. The two inboard heads serve the artificial feel simulator control valve, the wing spoiler differential pressure switch and the flight recorder. Dynamic pressure from the starboard outer head is applied to the co-pilots airspeed indicator and machmeter at all times, and to the air data sensor and navigators airspeed indicator when the selector valve is at NORMAL.

Eight static vents are arranged in two quadruple assemblies, located one on each side of the nose. The vents provide the source of static air for the airspeed indicator, machmeter, rate-of-climb and altimeter instruments, the wing spoiler differential and cabin differential pressure switch, the air data sensor, the cabin differential pressure indicator, cabin pressure control, artificial feel simulator control valve, the forward cabin pressure outflow valve and the flight recorder. A static vent on the starboard side of the rear fuselage feeds static air to the two rear cabin pressure outflow valves.

A. Pitot-Static Selector Valve

A two-position selector, located on co-pilots side panel, will shut off pitot and static pressures to the auto pilot air data sensor and the navigators airspeed indicator and altimeter when the valve is placed to CO-PILOT INSTR. ONLY. In NORMAL, the air data sensor and navigators instruments receive pitot and static pressures. The co-pilots instruments are connected upstream of the selector valve and receive pitot and static pressure at all times.



Pitot-Static System - Schematic
Figure 2

6. Maximum Operating Airspeed Aural Warning System

The maximum operating airspeed aural warning system is used to inform the pilot that the aircraft has exceeded the maximum operating speed for the selected zero fuel weight. This is accomplished by an aural warning device (cricket tone) activated by the airspeed warning switch. The airspeed warning switch is preset to the zero fuel weight of the aircraft. A test switch is provided to enable the pilot to test the operation of the system.

A. Airspeed Warning Switch

The airspeed warning switch unit is located on the main electrical distribution panel and contains a cam-adjusted switch. To adjust the switch, a knob is provided at the left-hand bottom corner on the face of the unit. For different zero fuel weights, the knob is rotated until the index pointer indicates the correct weight on the graduated scale.

B. Aural Warning System Test Switch

To simulate the overspeed condition, a test switch is located to the left of the airspeed warning switch. The switch is used to test the aural warning system, but does not check the mechanical operation.

C. Operation

The airspeed warning switch power is supplied from the 28-volt d.c. emergency bus, which energizes the control relay inside the unit and opens the relay contacts. When the aircraft exceeds the maximum operating speed, 28-volt d.c. power is fed to the aural warning device. The warning device (cricket tone), located on the main electrical distribution panel, operates until the airspeed is reduced to the maximum operating speed.

ALTIMETERS

Three sensitive altimeters are installed, one each on the pilots, co-pilots, plus the Mode 'C' Transponder encoding altimeter installed at Navigators station. The instruments are connected to the aircraft static system and measure the pressure of the atmosphere by means of an aneroid assembly. Each instrument has a barometric scale which may be set by a small knob situated at the bottom left corner of the instrument. The pilots and co-pilots altimeters are provided with internal lighting, while the Navigators is externally illuminated by eyebrow lighting.

SERVICEABILITY CHECK

All three altimeters should be set of QNH which should be obtained immediately prior to the check. The altimeters should then read the same altitude as the airfield elevations ± the following tolerances.

AIRFIELD ELEVATION (FEET)	TOLERANCE (± FEET)
- 1000	50
0	50
+ 500	50
1000	50
2000	55
3000	60
4000	60
6000	65
8000	85

SECTION 15

LANDING GEAR

1. General

The landing gear is a fully retractable tricycle type incorporating oleo-pneumatic shock struts. The main landing gear retracts rearward into the inboard nacelles and the nose landing gear forward into the fuselage. When retracted, the gears are completely enclosed by doors within the faired lines of the nacelles and the forward fuselage.

The main landing gear consists of two identical units, each consisting of a four-wheeled bogie pivoted on an oleo-pneumatic shock strut, the strut being hinged at its upper end to the wing box spar. A telescopic radius rod locks each unit in the down position. When retracted, each gear is retained in the up position by an uplock.

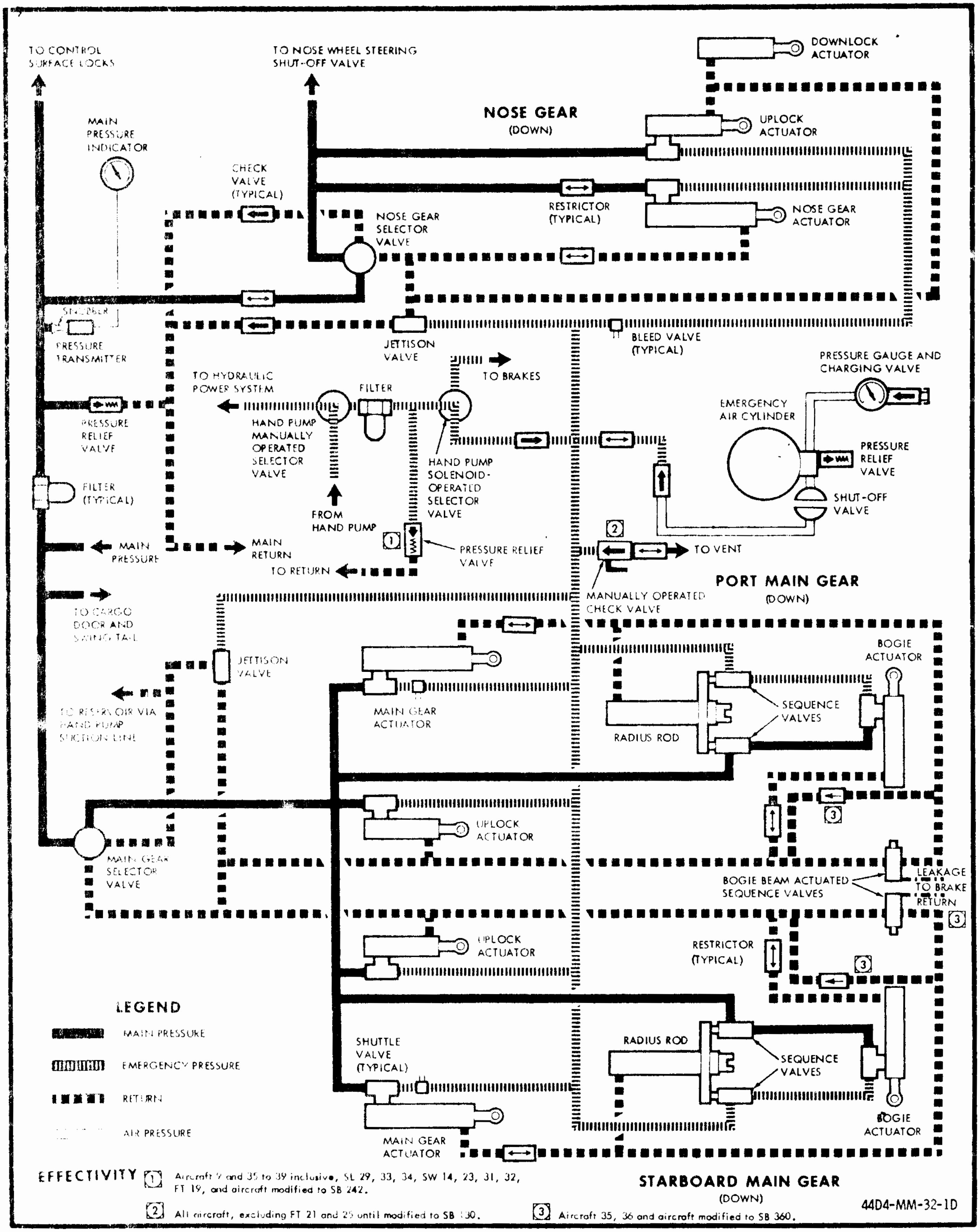
The nose landing gear consists of an oleo-pneumatic shock strut with a live axle, mounting co-rotating dual wheels to provide shimmy damping. The shock strut is swung from a cross-beam in the nose of the fuselage, is laterally braced by struts and has a folding radius rod which transmits fore-and-aft loads. When retracted, the nose gear is retained in the up position by an uplock.

Each main wheel incorporates a hydraulically operated individual brake unit and an anti-skid system is provided which automatically prevents the wheels from skidding, thereby permitting the required maximum braking pressure to be utilized at all times.

The nose landing gear is steerable and has a self-centering device incorporated in the shock strut to ensure that, when extended, the shock strut returns to the central position.

The doors which enclose each main gear in the nacelles are arranged in three pairs and are operated through mechanical linkage by the gear. The forward and centre pairs open and remain open when the gear is lowered, while the rear pair, after opening to permit passage of the gear, return to the closed position.

The nose gear doors are arranged in two pairs and are operated through mechanical linkage by the nose landing gear. When the nose gear is lowered,



EFFECTIVITY

① Aircraft 9 and 35 to 39 inclusive, SL 29, 33, 34, SW 14, 23, 31, 32, FT 19, and aircraft modified to SB 242.

② All aircraft, excluding FT 21 and 25 until modified to SB 130.

③ Aircraft 35, 36 and aircraft modified to SB 360.

Landing Gear Hydraulic System - Schematic
Figure 1

the rear pair of doors open and remain open, whereas the forward pair, after opening to permit transit of the gear, return to the closed position.

The landing gear is controlled by a selector lever located on the landing gear control panel. The landing gear is retracted and lowered by hydraulic pressure supplied by the aircraft hydraulic system. Provision is made for lowering the landing gear in an emergency by air from an emergency air system, or by a direct circuit from the hydraulic hand pump.

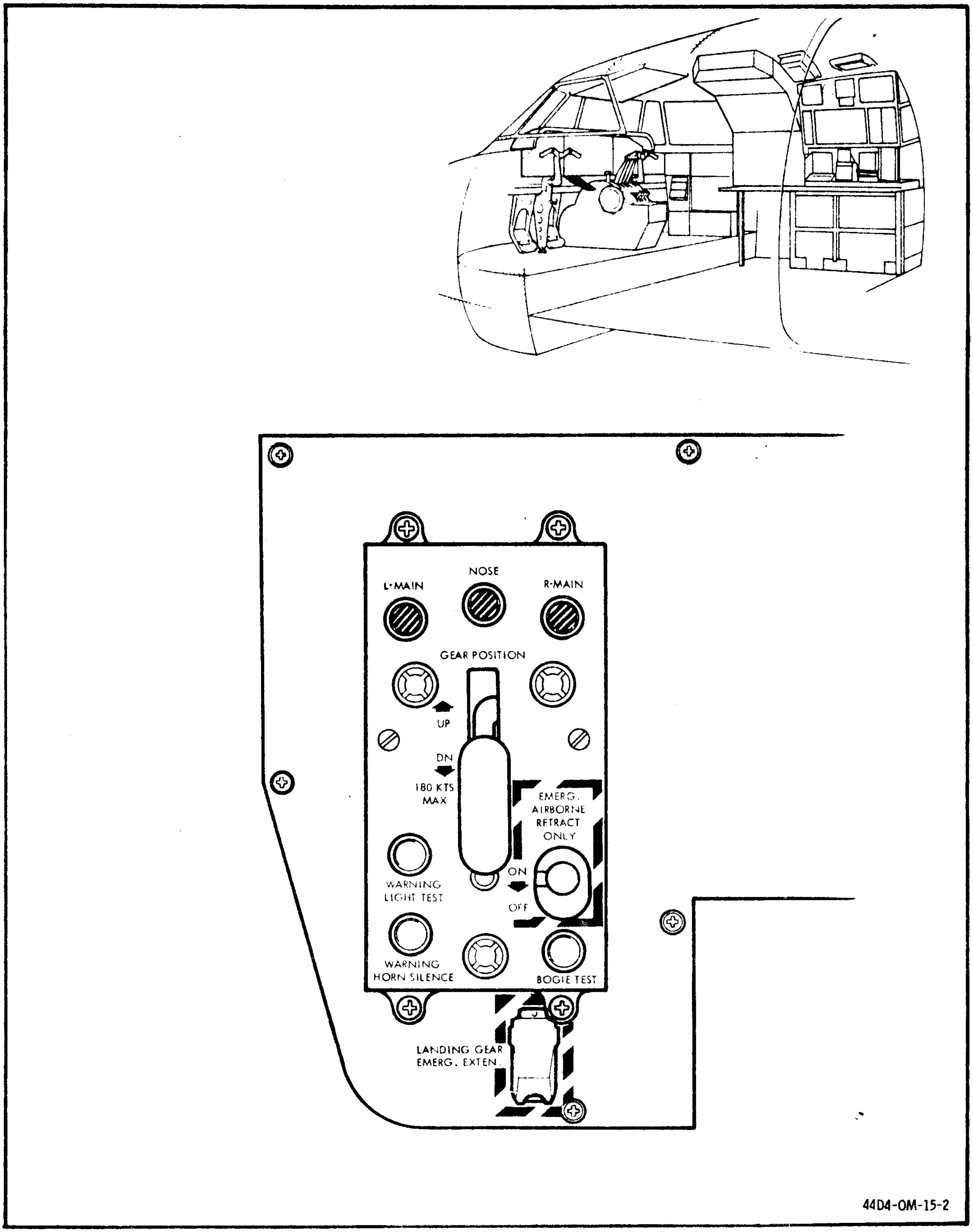
The aircraft has various safety circuits which are controlled by one or more of the three ground safety microswitches, one on each shock strut. These circuits include one which prevents movement of the landing gear selector lever from the down position when one or both of the main gear shock struts are compressed. Another circuit, controlled by the microswitch on the nose shock strut, ensures that nose wheel steering is only possible when the microswitch is energized by compression of the shock strut.

2. Operation (Ref. Fig. 1)

Operation of the landing gear by means of the hydraulic power system is as follows: Movement of the landing gear selector lever mechanically operates the electrical circuits of the main and nose landing gear solenoid-operated selector valves to direct pressure fluid to the landing gear up or down lines, according to the selection made. Lines not in use as pressure supply serve as return.

When an UP selection is made, pressure fluid is supplied by the main landing gear selector valve, via restrictors, to the bogie actuators to rotate and lock the bogies in position behind the respective shock struts. At the same time, pressure fluid supplied to the uplock actuators withdraws the respective actuator pistons out of contact with the actuating levers. Pressure fluid is also supplied to the inlet side of the jettison valve in the main gear circuit, and to the two bogie-actuated sequence valves. These two sequence valves are actuated by the respective bogies on attaining the fully rotated position. Actuation of the sequence valves directs fluid to the radius rods to break the downlocks and, via restrictors, to the two main gear actuators to retract the gears.

Engagement of a gear with the uplock actuates the uplock microswitch to give indication at the pilots station that the gear is locked up. The actuation of both gear uplock microswitches removes power from the main landing gear selector valve, permitting the valve to return to the neutral position, thereby relieving hydraulic pressure from the up lines. Fluid displaced from the down lines passes through the selector valve and via the hand pump suction line, to the reservoir.



Landing Gear Control Panel
Figure 2

Simultaneously, pressure fluid is supplied, via a restrictor, to the nose landing gear selector valve, the valve directing the fluid to the uplock actuator to withdraw the piston, to the downlock to release the lock, and, through a restrictor, to the nose gear actuator to retract the gear. Pressure fluid is also directed to the inlet side of the nose gear jettison valve. Engagement of the gear with the uplock actuates the uplock microswitch to give indication at the pilots station that the nose gear is locked up. Actuation of the microswitch also removes electrical power from the nose landing gear selector valve, permitting the valve to return to the neutral position and thereby relieving hydraulic pressure from the nose gear up lines. Fluid displaced from the down lines passes through the selector valve and a check valve into the return line to the hydraulic reservoir.

When a down selection is made, pressure fluid is supplied through the main landing gear selector valve, via the respective shuttle valves, to the uplock actuators to release the uplocks and to the main gear actuators to lower the main gears. Fluid is also supplied to the down sequence valves. These are actuated by strikers on the radius rods, when the gear is fully extended, to direct the pressure fluid, via the respective shuttle valves, to the bogie actuators. The bogie actuators, on release of the internal locks, retract to rotate the bogies to the landing position. Actuation of a downlock microswitch by engagement of the downlock, together with actuation of the bogie rotation microswitch on the bogie attaining the landing position, gives indication at the pilots station that the gear is locked down. Fluid displaced from the up lines during gear lowering passes through the selector valve and via the hand pump suction line, to the reservoir.

Simultaneously, pressure fluid is directed, via the restrictor in the supply line, to the nose landing gear selector valve. The selector valve directs the fluid to the nose gear uplock actuator, via the shuttle valve, to release the uplock and, via a restrictor and a shuttle valve, to the gear actuator to lower the gear. Pressure fluid is also directed to the nose wheel steering shut-off valve. Engagement of the nose gear with the downlock actuates the downlock microswitch to give indication at the pilots station that the nose gear is in the locked down position. Fluid displaced from the up lines passes through the nose landing gear selector valve and the check valve into the return line to the hydraulic reservoir.

3. Operating Controls and Indicators (Ref. Fig. 2)

Operation of the landing gear is controlled from the landing gear control panel on the pilots lower centre instrument panel. The control panel contains the landing gear selector lever, three position indicators, a warning light test button, an emergency retract button, a bogie test button and a warning horn silence button.

The landing gear selector lever is a two-position control marked UP and DN. A warning light is installed in the end of the lever which illuminates whenever one or more of the gears is in any position other than that selected. The light also illuminates, in conjunction with the sounding of a warning horn, if one or more of the power levers is in the retarded position when the aircraft is below 8000 feet with the landing gear not in the locked down position. The warning light test button is provided to test the serviceability of the light. The horn silence button can be used to silence the horn, if desired. The warning horn will sound when the gear is up and the flaps are extended beyond 30°. Under this condition, the horn silence button cannot silence the horn. The position of each of the three gears is displayed by individual indicators. When the nose and main gears are in the locked down position, each of the three indicators displays a wheel. When a gear is not locked in the position indicated by the landing gear selector lever, a diagonally striped disc shows in its indicator. When the gears are locked up, each indicator displays the word UP.

The bogie test button is provided to confirm that the downlocks of the landing gear are engaged. The button is used when a down selection has been made and the warning light in the selector lever remains illuminated and one or both of the main gear indicators show a diagonal stripe. Operation of the button makes an independent ground for the downlock microswitch, and if a safe condition is then displayed, the downlocks are engaged and the fault is in the bogie rotation system.

The emergency retract button is used when the solenoid lock on the landing gear selector lever fails to release after the aircraft has become airborne. Operation of the button bypasses the solenoid lock, allowing an up selection to be made.

CAUTION: EMERGENCY USE OF THE LANDING GEAR SELECTOR LEVER LOCK OVERRIDE TO OBTAIN RETRACTION OF THE GEAR IS TO BE CONFINED TO AIRBORNE CONDITION ONLY. EMERGENCY USE OF THE OVERRIDE DURING TAKE-OFF OR LANDING WITH THE WEIGHT OF THE AIRCRAFT ON THE LANDING GEAR MAY RESULT IN ONLY THE NOSE LANDING GEAR RETRACTING, SINCE THE MAIN LANDING GEAR BOGIE MUST ROTATE BEFORE THE DRAG STRUT CAN EXTEND AND ALLOW THE RETRACTION CYLINDER TO START RETRACTING THE MAIN LANDING GEAR.

A. Emergency Extension Switch

An emergency extension switch is located below the landing gear control panel. The switch, guarded and safetied in the off position, is marked LANDING GEAR EMERG. EXTEN. When selected, a solenoid-operated valve on a 3000-psi air bottle opens to discharge compressed air into the emergency delivery lines to the down side of the landing gear actuator.

The system will extend and lock the gear down regardless of the position of the selector lever. After operation of the emergency extension switch, no attempt should be made to raise the landing gear until the air pressure in the lines has been released by operation of the emergency air vent valve lever.

AA. Emergency Air Vent Valve Lever

The emergency air vent valve lever is located on the floor of the flight compartment at the base of the MDP and is accessible through a panel marked EMERGENCY AIR VENT VALVE. The lever is normally in the up or closed position. After lowering the landing gear by the emergency extension switch, the air vent valve must be moved to the down or open position to vent overboard the air pressure in the emergency down lines. The lever should be left in the down position for sixty seconds and then returned to the up position before the hydraulic system is loaded or any attempt is made to raise the landing gear. In addition, the emergency air supply line incorporates a permanent bleed vented to atmosphere to prevent leakage of hydraulic fluid into the emergency down lines from hydraulically locking the gear.

B. Handpump

The handpump may be used to lower the landing gear or power the wheel brakes by moving the handpump manual selector valve from the safety wired MAIN SYSTEM position to the L.G. EMERG & BRAKE ACC position. Pressure developed by the handpump is then directed to an electrically operated valve. This valve is controlled by a two-position switch called HAND PUMP SELECTOR on the systems operators hydraulic control panel. The two positions are marked LANDING GEAR and EMERG BRAKE.

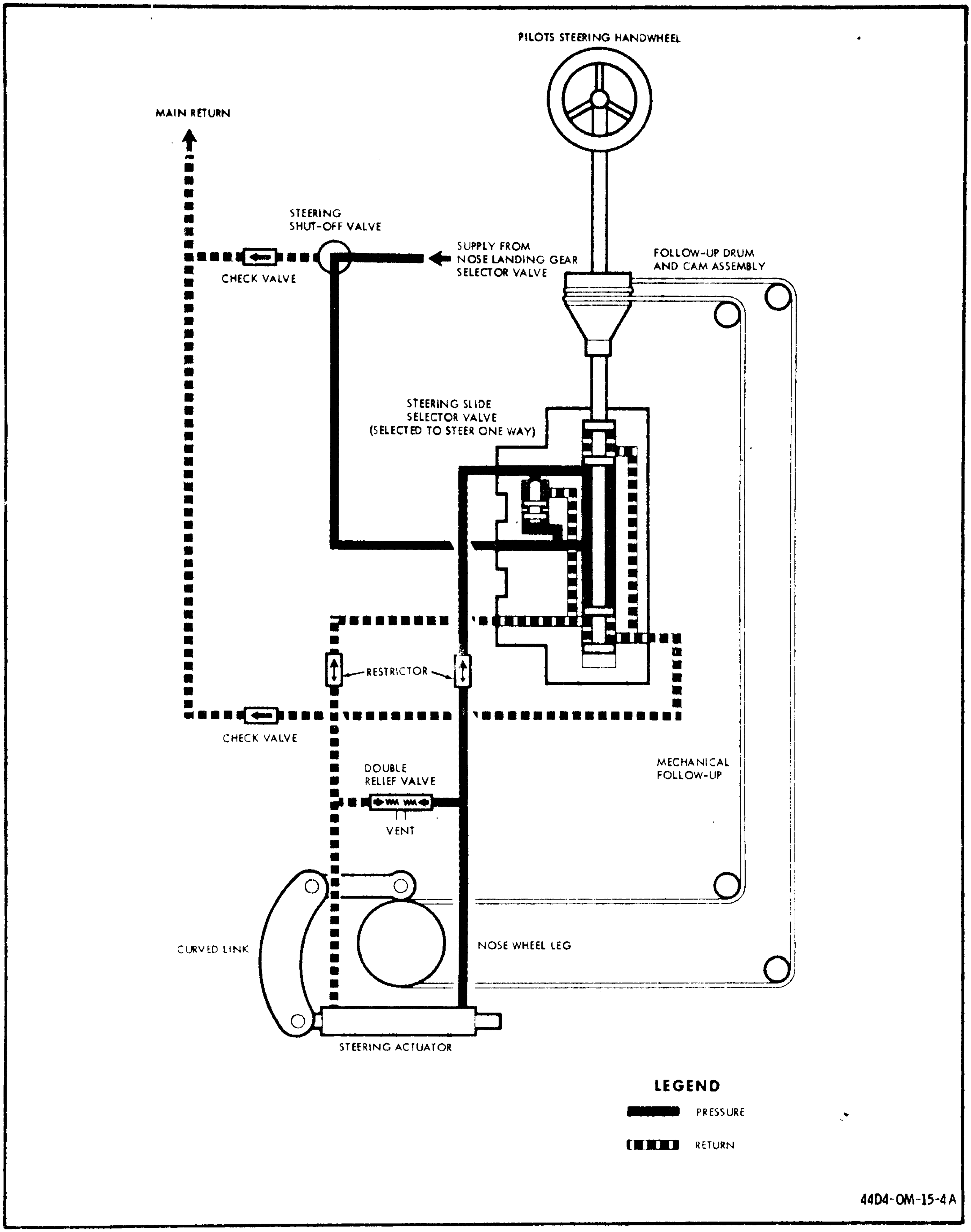
In the LANDING GEAR position, the pressure is routed by a direct line to the landing gear uplocks and the down side of the actuators, extending and locking the gear.

With the switch in the EMERG BRAKE position, the handpump pressure is routed to the brake accumulators, thus supplying braking power.

C. Landing Gear Ground Lock Pins

Landing gear ground lock pins are provided for the nose landing gear and each main landing gear.

The nose landing gear ground lock pins should be fitted as soon as possible after the aircraft has landed and the taxi run is completed and are to remain fitted when the aircraft is towed or at rest. The pins are to be removed only for maintenance purposes when the aircraft is jacked up or prior to flight.



Nose Wheel Steering - Schematic
Figure 3

The main landing gear ground lock pins are not required except for gear retraction checks with the aircraft on jacks. The pins are not to be installed during ground running and taxiing.

4. Nose Wheel Steering (Ref. Fig. 3)

The nose wheel steering system provides directional control of the aircraft for ground manoeuvring. The system is controlled by hydraulic power which positions the nose wheels relative to the angle selected on a handwheel in the flight compartment. Hydraulic power is provided by the main hydraulic power system through the nose landing gear selector valve when the gear is selected down and the shock strut compressed. The steering can be rendered inoperative by a switch located adjacent to the steering handwheel.

Movement of the handwheel is transmitted through bevel gears and a torque tube to a cam assembly and the steering slide selector valve. Rotation of the cam assembly input shaft produces a linear movement of the steering slide valve, which passes hydraulic pressure to one side of the actuator. The actuator cylinder is mounted on the rear of the leg in a trunnion mounting, the piston-rod being connected through a linkage and co-rotating sleeves to the toggle links and the nose wheels. Full movement of the actuator provides 50° of steering to each side of centre.

To prevent the actuator from travelling full stroke each time it is operated, a follow-up drum, which forms part of the steering cam assembly, returns the steering slide selector valve to neutral when the nose wheels are correctly positioned in relation to the angle selected on the steering wheel. The drum is driven by a chain, cable and shaft system from the lower part of the shock strut. The steering actuator can be disconnected from the wheels when the aircraft is on the ground by a disconnect pin. This facilitates ground handling and permits the wheels to be turned through 360°.

A microswitch is located at the lower end of the leg and is actuated by a cam on the rotating sleeve assembly. The microswitch operates a warning horn in the nose landing gear bay if the permissible towing angles are exceeded. A pointer at each side of the leg provides visual indication of the safe towing angles. If the aircraft leaves the ground with the nose wheels deflected, a self-centering cam assembly in the shock absorber returns the wheels to the neutral position so that the wheels can be retracted without damage.

A. Nose Wheel Steering Control

Control for the nose wheel steering consists of a handwheel and a disconnect switch. The handwheel is located on the left side of the flight compartment convenient to the pilot. A raised pip on the periphery of the handwheel indicates the straight ahead position when at the top. The disconnect switch, located adjacent to the handwheel, permits free castoring of the nose wheel when required.

5. Wheel Brakes (Ref. Fig. 4)

The wheel brakes are powered from the aircraft hydraulic power system and controlled by the brake pedals at each pilots station. A brake control valve, located in the nose landing gear bay, is operated by mechanical linkage from the brake pedals. The brake pedals are interconnected to provide braking control from either pilots station. The left brake pedal at each pilots station controls the brakes on the port main landing gear, while the right pedals control the brakes on the starboard main landing gear. Differential braking is available and depends upon the forces applied to the brake pedals. Two parking brake control levers, mounted inboard of each pilots rudder pedals, are connected by mechanical linkage to the brake control valve.

The brake hydraulic system is divided into two independent sub-systems, designated No. 1 and No. 2 brake sub-systems. The No. 1 sub-system supplies pressure to the front brakes on each main landing gear, while the No. 2 sub-system powers the rear brakes. Thus failure of either sub-system will affect only the four brakes powered by that sub-system, reduced braking being available from the remaining serviceable sub-system. Pressure gauges for the two sub-systems are on the systems operators hydraulic control panel.

Brake system metering valve solenoids are energized through ground safety switches on the port main gear and nose landing gear and through contacts on the landing gear warning light relay. When the weight of the aircraft is off the landing gear, the metering valve solenoids are energized and no brake pressure is available to the wheels. This is to prevent possible damage to the landing gear resulting from the operation of brakes after take-off.

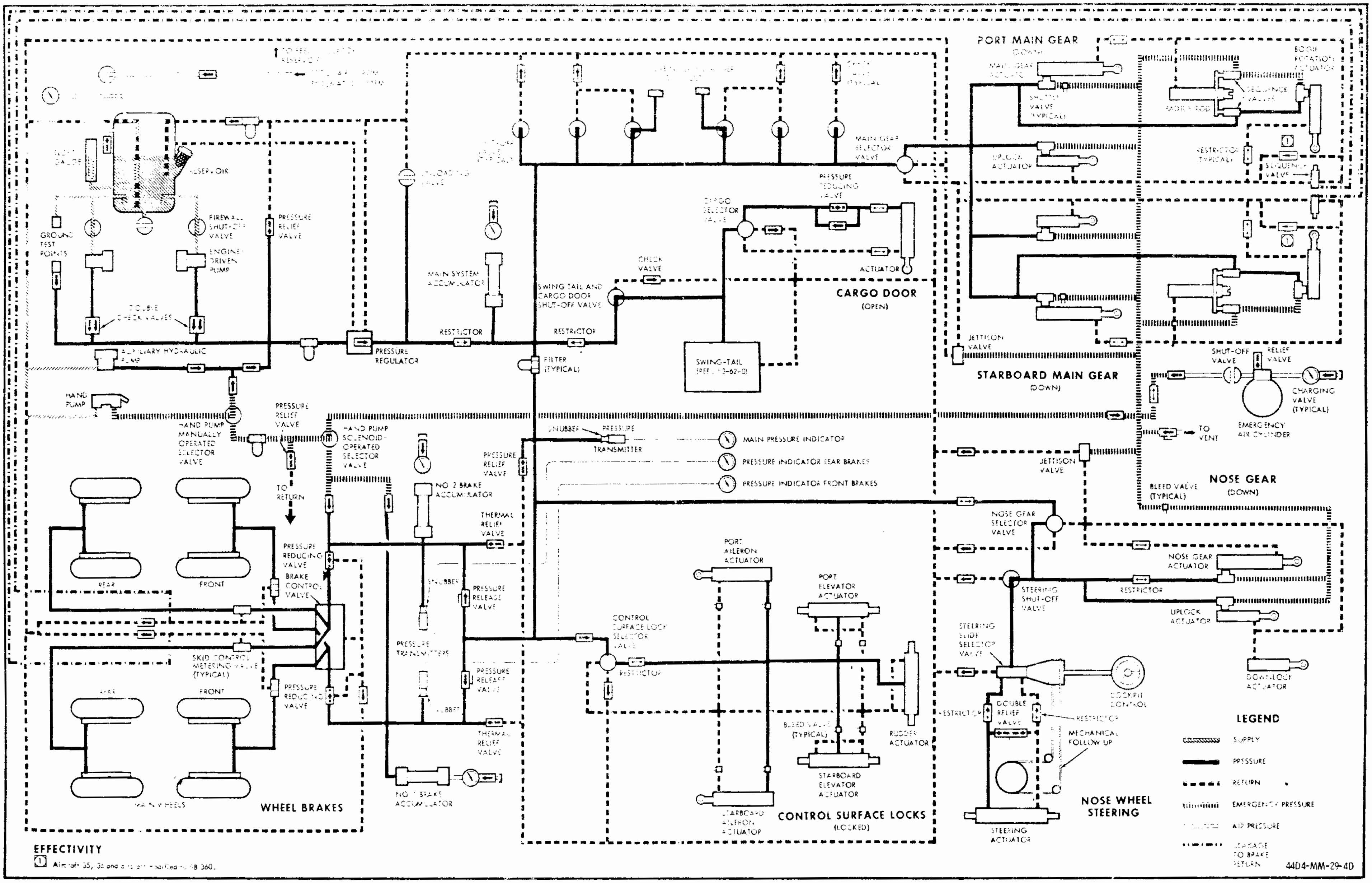
With the aircraft on the ground, power to the ground safety relays is removed and the metering valve solenoids are de-energized to provide brake pressure. Similarly, when one or more power levers are below the FLIGHT IDLE position, the landing gear warning light relay is energized and power is removed from the metering valve solenoids to ensure that brake pressure is available regardless of the position of the ground safety switches.

A Bendix electrohydraulic anti-skid system monitors the hydraulic pressure in the wheel brake units. This system employs an electrical control to detect an incipient skid and prevents the skid by reducing the hydraulic pressure in the brake units. In the event of malfunction in the system, warning of which is given through the master caution lights and the pilots annunciator panels, a switch on the pilots overhead panel marked WHEEL BRAKES ANTI-SKID SYSTEM is used to de-energize the anti-skid system.

6. Power Sources

The circuit-breakers and power sources for the landing gear and anti-skid systems are as follows:

(1) Constant-frequency A.C. Bus Panel A	Quantity
Anti-skid Braking System	1



Brake Hydraulic System - Schematic
Figure 4

SECTION 16

OXYGEN SYSTEM

1. General

A high-pressure fixed oxygen system supplies gaseous oxygen from a storage cylinder in the forward hold or from two (2) storage cylinders at the co-pilots position to individual pressure demand type regulators located one at each of the four crew stations. A portable oxygen unit, stowed underneath the pilots seat, will enable a crew member to move about the aircraft under conditions necessitating supplementary oxygen.

2. Fixed Oxygen System

The fixed oxygen system consists of an oxygen storage cylinder, a line valve, a pressure gauge, four diluter-demand regulators and four full-face oxygen masks. The masks are suitable for protective breathing purposes.

2.1. Fixed Oxygen System (Modified System)

The fixed oxygen system consists of two (2) oxygen storage cylinders, two (2) pressure gauges, four (4) pressure demand regulators and four (4) full-face oxygen masks. The masks are suitable for protective breathing purposes.

A. Oxygen Storage Cylinder

The oxygen storage cylinder is located in the below-floor area, outboard of the port side of the forward hold. When fully charged to 1800 psi (70°F), the cylinder capacity is 1800 litres STPD. The cylinder is mounted horizontally with its shut-off valve and pressure gauge on the forward end. A safety disc is built into the head and ruptures at approximately 2800 psig.

A.1. Oxygen Storage Cylinder (Modified System)

The oxygen storage cylinders are located on the floor to the right of the co-pilots seat. When fully charged to 1800 psi (70°F), each cylinder capacity is 1800 litres STPD. The cylinders are mounted horizontally with the shut-off valve and pressure gauge on the aft end. A safety disc is built into the head and ruptures at approximately 2800 psig.

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Oxygen System
Figure 1

B. Line Valve and Pressure Gauge UNMODIFIED SYSTEM

A line valve, which controls the system supply, is located on the port side of the aircraft to the left of the pilots seat. A pressure gauge is located on the systems operators lower panel and indicates system pressure when the cylinder valve and line valve is open.

C. Diluter-Demand Regulators

A narrow panel pressure-breathing diluter-demand regulator is located at each crew station. The regulators operate automatically but override controls are provided. Each regulator incorporates a blinker-type flow indicator and a relief valve which protects the regulator from excessive pressure. Two toggles are mounted on the regulators, a diluter toggle and an emergency control toggle. The two-position diluter toggle is marked 100% OXYGEN-NORMAL OXYGEN and the three-position emergency control toggle EMERGENCY-NORMAL-TEST MASK, the TEST MASK position being spring-loaded to NORMAL.

When the diluter toggle is at NORMAL OXYGEN, the regulator will deliver on demand an air/oxygen mixture, the ratio which varies with cabin altitude, being automatically regulated by an integral aneroid. As the cabin altitude increases, the proportion of air decreases until at approximately 30,000 feet, 100% oxygen is delivered to the mask. With the diluter toggle at 100% OXYGEN, the regulator will deliver on demand 100% oxygen at any altitude.

The NORMAL position of the emergency control toggle allows the regulator to deliver oxygen or oxygen/air mixture at ambient cabin pressure at cabin altitudes up to approximately 30,000 feet. If this altitude is exceeded, the regulator will begin to deliver oxygen at a positive pressure increasing with altitude. If a positive pressure is required below 30,000 feet cabin altitude, the toggle may be placed in the EMERGENCY position and oxygen will be supplied under a positive pressure of 3.5 inches of water above cabin pressure. The TEST position of the toggle produces a flow under pressure of 11 inches of water above cabin pressure. The blinker-type flow indicator shows white when an inhalation is made and oxygen is flowing through the regulator. When the inhalation ceases, the indicator blinker shows black.

3. Portable Oxygen Unit

The portable oxygen unit, stowed beneath the pilots seat, consists of a cylinder, pressure gauge, shut-off valve, demand regulator, face mask and hose. The cylinder is of the high-pressure type and when filled to 1800 psi (70°F) will provide 200 litres STPD. The demand regulator commences to pass

Deleted

Drop-down Oxygen Mask Stowage Box
Figure 2

3. Portable Oxygen Unit (Cont'd)

oxygen from the cylinder as soon as it senses the suction produced by the inhalation of the user, provided the cylinder shut-off valve is open. The regulator supplies 100% oxygen and there is no dilution feature.

A quick-disconnect fitting at the outlet of the regulator simplifies attachment and removal of the face mask hose. The face mask and hose are interchangeable with those used in the fixed oxygen system. The full-face mask and demand-type regulator combine to make the assembly suitable for protective breathing.

SECTION 17

POWER PLANT, FUEL SYSTEM AND OIL SYSTEM

1. Power Plant

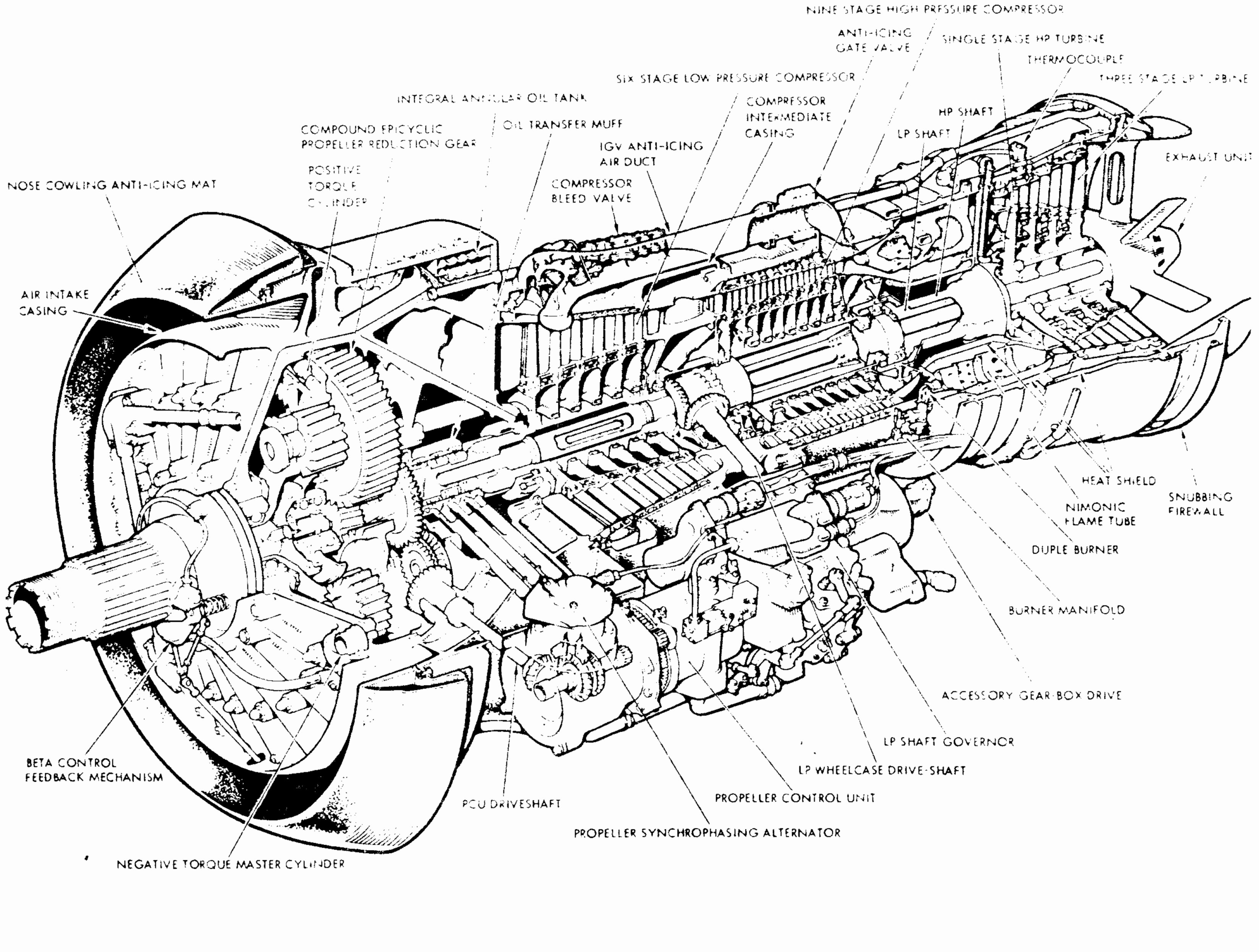
The power plant sections of the aircraft consist of the engine, cowling, engine mountings, equipment and accessories situated forward of the aircraft firewall in each nacelle. In addition, the jet pipe extending from the tail-pipe on the engine to the wing trailing edge is considered as part of the power plant. The design of the power plant permits rapid removal and/or replacement of the engine or engine quick-change unit. All plumbing forward of the aircraft firewall is fireproof or fire resistant and all fluid couplings which need to be disconnected during engine or accessory change are of the quick-disconnect self-sealing type.

A. Engines

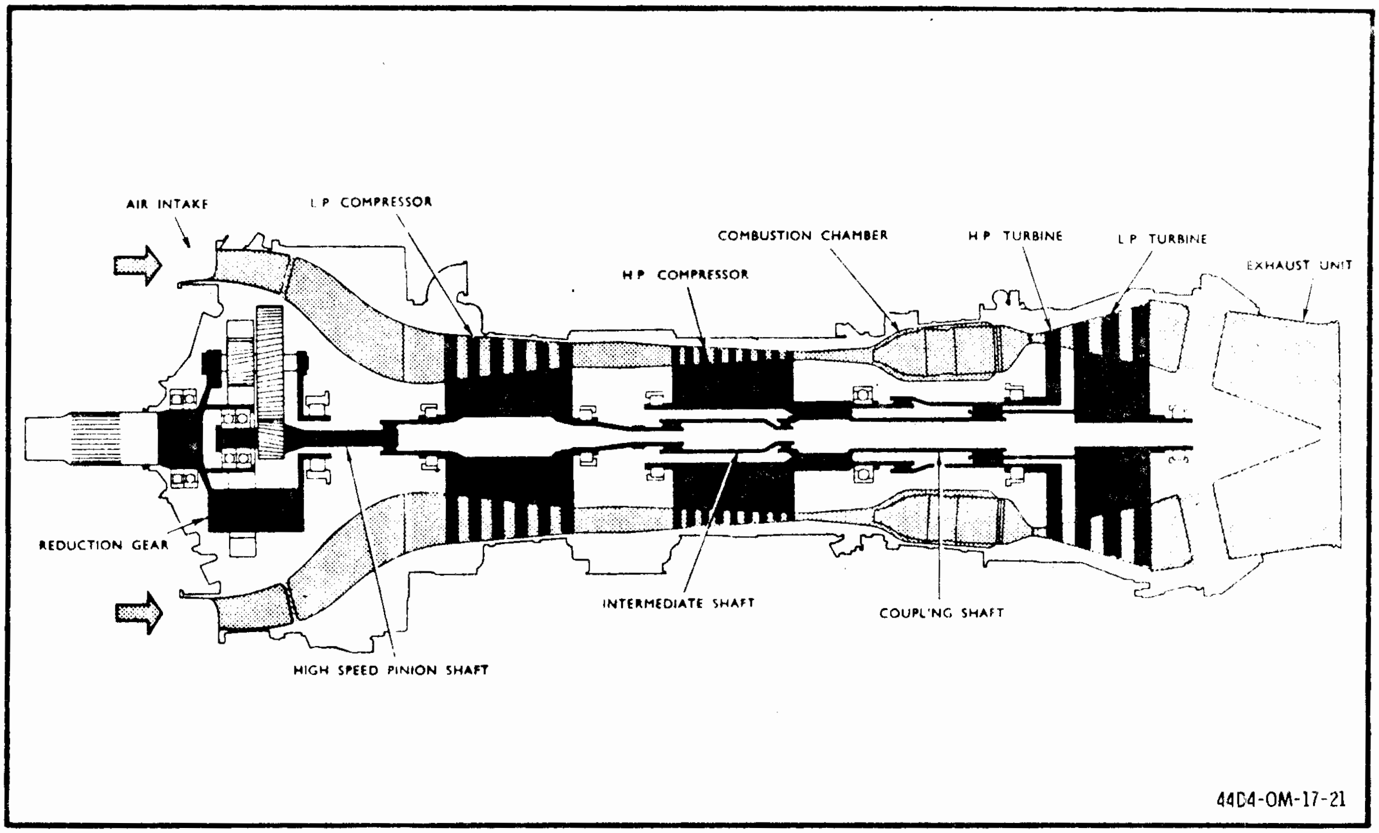
The aircraft is powered by four Rolls-Royce Tyne 12 Mk515 high pressure ratio propeller-turbine engines incorporating two axial-flow compressors driven by separate turbines through coaxial shafts (Ref. Fig. 1). Each engine develops, at static sea-level ISA conditions, an average of 5305 shaft horsepower (SHP) at 99.8% (15,250) low pressure compressor rpm (LP rpm) with a jet thrust of 1110 pounds giving a total equivalent horse power (TEHP) of 5730.

The engine consists mainly of a six-stage low pressure compressor coupled to a three-stage turbine, a nine-stage high pressure compressor coupled to a single-stage turbine, and ten flame tubes. (Ref. Fig. 2.) The low pressure (LP) and high pressure (HP) compressor shafts are separate but concentric, the LP shaft driving a propeller via an epicyclic-type reduction gear (0.064:1) which converts the engine speed to a value acceptable to the propeller. A torquemeter system, registering both positive and negative torque, is incorporated in the reduction gear. Both the engine and propeller rotate counter-clockwise when viewed from the rear.

The combustion system is of the tubo-annular type and consists of ten flame tubes housed in a cylindrical chamber formed by the combustion chamber outer casing and an internal intermediate casing. Each flame tube is equipped with a fixed orifice duple burner projecting into the flame tube head.



Tyne 12 Engine - Cutaway
Figure 1



Gas Flow Diagram
Figure 2

B. Engine Accessories

The engine accessories are driven from two wheelcases located on the lower perimeter of the engine intermediate casing between the LP and HP compressors. One wheelcase is driven from the LP compressor shaft and the other from the HP compressor shaft, via internal spur and bevel gears, an inclined shaft and a fore-and-aft horizontal shaft. An inclined shaft from the reduction gear drives the propeller control unit and the propeller synchrophasing unit. Aircraft accessories are driven, via a power take-off point on the LP wheelcase, from a gear-box mounted on the engine firewall.

C. Firewalls and Ventilation

Fire risk is minimized by dividing the engine bays into ventilated compartments or zones by means of vertical and horizontal firewalls. A fireseal, secured to the front flange of the integral heat shield surrounding the engine combustion chambers, in conjunction with a vertical airframe-mounted fireproof bulkhead, form a firewall which separates the relatively cool compressor compartment (Zone 1) from the hot combustion chamber section (Zone 2).

Zone 2 is totally enclosed by the firewall and a fireseal incorporated in a vertical airframe-mounted bulkhead and also by a horizontal firewall beneath the combustion chambers which isolates Zone 2 from the engine-driven aircraft accessories section (Zone 1A). A compartment, known as the nacelle protected area, is bounded by a firewall, the wing front spar and the nacelle profile in that area.

D. Positive and Negative Torque System

The positive torque system provides indication of engine power output and, in addition, provides a hydraulic balance to the torque applied to the reduction gear annulus from the planet gears. The negative torque system is the engine component of the automatic drag limiting system (ADLS), a primary flight safety system which eliminates excessive drag in the event of engine failure or propeller malfunction,

Automatic cancellation of this feature, under normal negative torque conditions when operating in the flight idling and Beta range, is obtained by providing a hydraulic balance to the reverse torque load applied to the reduction gear annulus. Although their duties and functions are separate, the torquemeter and negative torque systems are mechanically interdependent units.

The oil supply for the system is provided by a gear-type pump mounted in the reduction gear casing and driven by a spur gear bolted to the reduction gear. The pump also delivers oil to a variable datum relief valve mounted on the rear face of the oil tank. The relief valve consists of the valve assembly and an operating shaft with an integral arm carrying a bearing capable of varying the spring loading of the valve. The operating shaft is connected to the power lever and the controls are so arranged that, when the power lever is in any position between take-off and cruise, the valve is open a fixed amount and oil spills into the reduction gear to scavenge and maintain a hydraulic load on torquemeter pistons. Any variation in engine operating conditions results in movement of the annulus gear and consequent resetting of a spill valve. Resetting action of the spill valve corrects the hydraulic pressure so that it is maintained proportional to propeller shaft torque, thus restoring the state of balance. If engine power fails, the propeller windmills and the resultant torque rotates the annulus gear in reverse. The lug on the rim of the annulus gear then actuates a control linkage to the PCU to increase the propeller pitch and decrease the drag.

With the power lever at the flight idling position and in the Beta range at touchdown, the relief valve is closed and the datum is varied by increased spring loading on the valve. As the annulus gear rotates in reverse, movement of the torquemeter pistons is resisted by pump pressure and the pump output maintains sufficient load to balance the negative torque on the annulus. This prevents the annulus gear from rotating sufficiently to operate the ADLS, the design of the relief valve being such that, in this range, the hydraulic load will always be greater than any possible negative torque loading. Indicators, located on the pilots instrument panel, give indications of torque pressure and, hence, engine power output.

E. Compressor Bleed Valve

The LP and HP compressor stages are matched to give optimum performance at normal operating speeds. However, under certain conditions, such as descent or during slam accelerations and decelerations, the relative compressor speeds become unmatched. To obviate LP compressor surge under these conditions, a progressively variable bleed valve, mounted on the intermediate compressor casing, allows a proportion of LP compressor delivery air to be bled overboard. The valve is actuated by a hydraulic ram, using fuel as an operating medium, the amount of valve opening being scheduled to a predetermined relationship of the LP and HP compressor speeds, with a correction for ambient temperature. In the event of fuel pressure failure, the bleed valve opens to a safe position.

The control unit consists basically of a movable control stem, centrally located in an outer casing. The free end of a Bourdon tube, connected by a capillary to a bulb located in the air intake casing, bears on one end of the stem. The other end of the stem is subject to the differential force exerted by two coil springs. LP shaft governor pressure acts on a diaphragm in the same sense as the Bourdon tube load and this force is opposed by the resultant of HP governor pressure acting on another diaphragm and capsule stack. A pillar, mounted on the stem between the two diaphragms, carries a spill valve, positioned to control the flow, through an orifice of fuel at restricted HP pump pressure. The flow from the orifice is returned to the LP side of the fuel system. The servo pressure created upstream of the orifice is transferred by internal drillings to the larger face of the ram piston. Other drillings transfer HP fuel pump delivery pressure to the other side of the piston. In ground running, the valve remains fully open to provide maximum bleed for auxiliary gear-box oil and 40-kva generator cooling.

F. Operation

When the engine is stationary, the control unit is so biased by the Bourdon tube load and the control spring that the spill valve is closed. This, however, has no effect on bleed valve position due to lack of fuel pressure, and the bleed valve is held open by the safety spring.

At idling conditions, when the LP compressor speed is maintained at the minimum constant speeding rpm by the PCU, but the HP compressor speed is low because of the small fuel flow, the bleed valve is open. The low HP governor pressure exerts a force which is insufficient to move the stem and open the spill valve. Servo pressure is thus at a maximum and the force it exerts on the larger face of the piston is greater than the force exerted by the HP pump pressure on the smaller face, and the bleed valve is held open.

At normal cruise conditions, the HP governor pressure is sufficient to move the stem and open the spill valve. Servo pressure is thus at a minimum and the bleed valve is kept closed.

If, during transient conditions, the compressor speeds become unmatched, the diaphragms are deflected by the corresponding variation in the pressure signals from the overspeed governors, and the spill valve is closed. This increases servo pressure to a value which moves the piston against the force exerted on the smaller face by pump delivery pressure, and the bleed valve starts to open. As the compressor speeds become rematched, the diaphragms are again deflected by the pressure signals and the spill valve opens, causing a subsequent drop in servo pressure, and the bleed valve moves to the closed position.

An increase in air intake temperature affects the airflow through the compressors and increases the tendency to surge. This is counteracted by the increased loading applied to the diaphragm assembly by the Bourdon tube. The increased loading ensures that the spill valve closes earlier and hence the bleed valve opens earlier if the compressor speeds become unmatched.

G. Cooling and Sealing

Cooling of the hot internal sections of the engine and the pressurization of seals which prevent oil or gas leakage is effected by tapping air from the LP and HP compressors (Ref.Fig.3). Air bled from the LP compressor pressurizes the seals of the reduction gear bearings, the LP and HP compressor shaft bearings, and the HP turbine bearings, and cools the rear face of stage 2, and both faces of stage 3 LP turbine discs, the turbine tail bearing and exhaust unit. Air bled from the HP compressor is ducted to cool both faces of the HP turbine and both faces of stage 1 LP turbine discs, and also the front face of stage 2 LP turbine disc.

To prevent heat transfer to the surrounding structure, the combustion chambers, the nozzle box, and the tail bearing housing and exhaust unit are surrounded by a steel shroud which serves as a heat shield. Holes in the flange induce ram air flow through the shroud by convection and this arrangement maintains a reduced external temperature at the rear of the engine. Ram air is used for cooling various engine-driven aircraft accessories, the engine compressor and combustion chamber compartments (Zones 1 and 2) and also, the engine, constant-speed drive and accessory gear-box oil coolers.

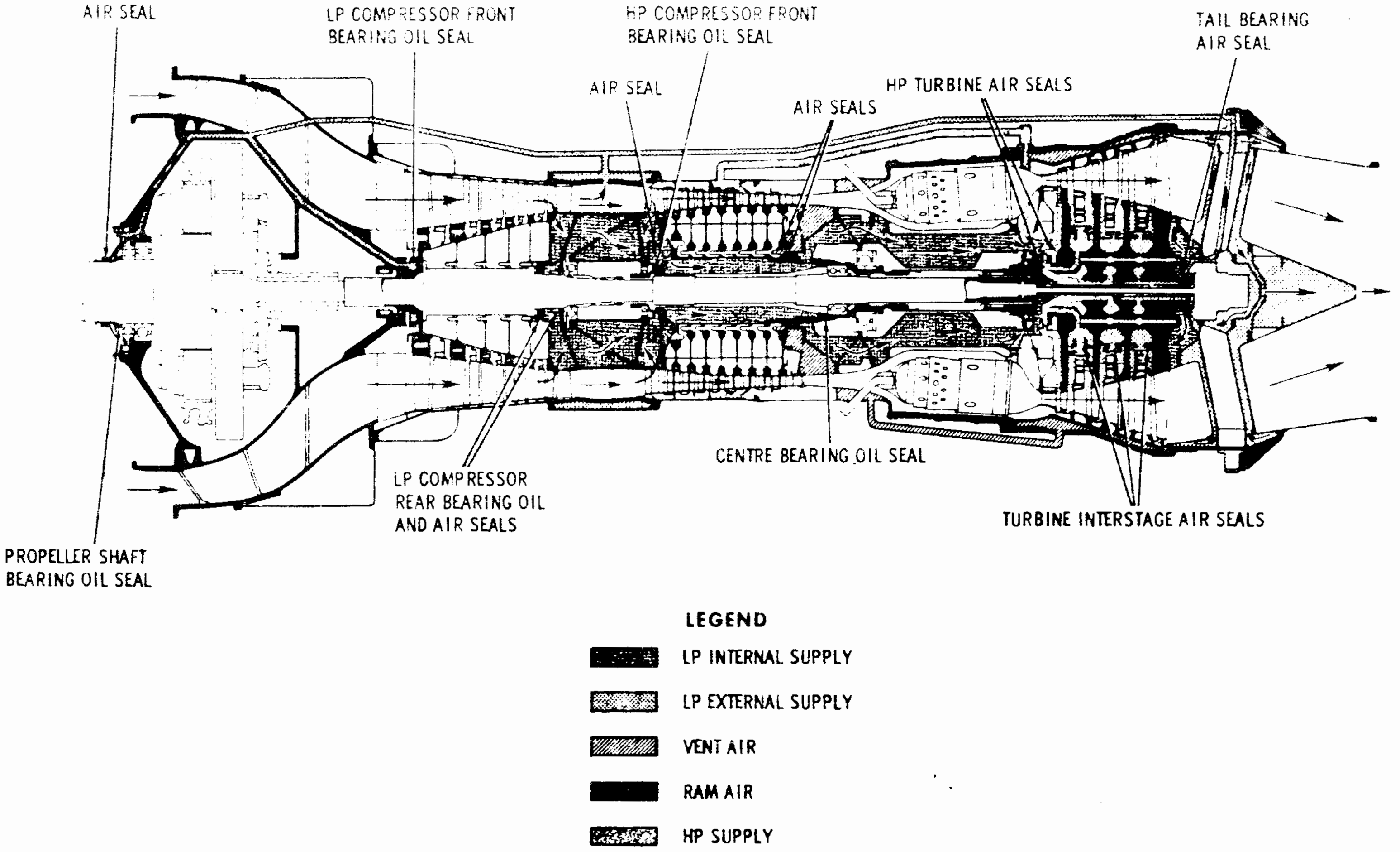
H. Beta Control

Beta, or propeller blade angle, control is provided to give smooth transition of thrust over the engine operating range from maximum Beta to maximum reverse positions of the power lever. Within the Beta range, engine rpm is no longer controlled by the PCU, but is dictated by the LP shaft governor. The governor incorporates a variable datum mechanism to provide a controlled engine speed range between 69% to 84.2% LP rpm (10,600 to 12,800 LP rpm). The governor trims the fuel supplied through the reverse throttle in the FCU and the resulting power and propeller blade angle are co-ordinated under control of the power lever to obtain the desired reverse thrust. The actual blade angle achieved is signalled to the PCU through a rod and lever mechanism and a yoke mounted on the nose casing. The feed-back and blade angle selector in the Beta range is also used in the normal flight range of the power lever to select a positive blade angle.

I. Hydromechanical Governors

There are two hydromechanical governors on the engine, a HP governor and an LP governor, each of which has a dual purpose:

(1) To govern the speed of the individual engine sections should they, for any reason, tend to overspeed the normal maximum rpm by a prede-


AIR SEAL
LP COMPRESSOR FRONT BEARING OIL SEAL
HP COMPRESSOR FRONT BEARING OIL SEAL
AIR SEAL
AIR SEALS
HP TURBINE AIR SEALS
TAIL BEARING AIR SEAL
PROPELLER SHAFT BEARING OIL SEAL
LP COMPRESSOR REAR BEARING OIL AND AIR SEALS
CENTRE BEARING OIL SEAL
TURBINE INTERSTAGE AIR SEALS
LEGEND
▩ LP INTERNAL SUPPLY
░ LP EXTERNAL SUPPLY
▨ VENT AIR
■ RAM AIR
▦ HP SUPPLY

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Cooling and Sealing Diagram
Figure 3

termined amount. Also, to govern the speed at which the LP governor controls can be varied, thus extending its function to become the engine speed control when operating in the Beta range.

(2) To produce a hydraulic force proportional to the rpm of its particular engine section to be used as an rpm differential signal to operate a compressor bleed valve.

The HP governor is, in effect, an addition to the HP engine fuel pump which is driven from the HP wheelcase. The LP governor is an individual unit and is driven from the LP wheelcase.

J. Exhaust System

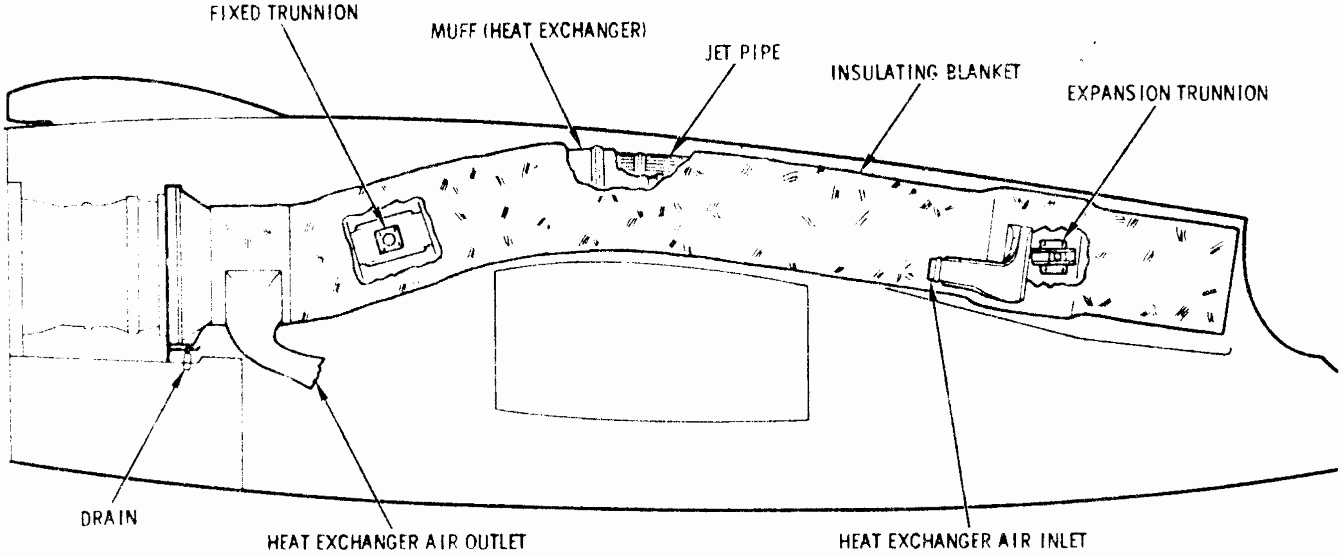
The power plant exhaust system, which conveys exhaust gases to atmosphere, consists of a jet pipe, surrounded by a heater muff, housed in a tunnel forming part of the upper nacelle structure. It extends over the wing rear spar and exits at the wing trailing edge. (Ref.Fig.4.)

The jet pipe, constructed of corrosion resistant steel, consists of three sections held together by clamps and safety plates. The front section is attached to a flange incorporated on one of the components of an engine snubbing assembly which forms part of the vertical firewall. Longitudinal heat transfer fins of channel section are welded to the exterior surface of the jet pipe. The pipe is surrounded by a muff-type casing which is positioned to permit flow of air over the jet pipe and the heat transfer fins. The outer surface of the heat muff is enclosed by insulating blankets lockwired in position.

Each muff assembly incorporates a pair of ram air intakes, located at the aft end of the muff, from which air, ducted from a forward facing scoop on top of each nacelle, passes forward under ram pressure over the jet pipe and heat transfer fins towards two outlets at the front end, thus absorbing heat from the exhaust gases passing through the jet pipe. The inboard muff outlets supply hot air to the wing anti-icing system and also to a primary heat exchanger for cabin heating and ventilating. The outlets from the outboard muffs supply hot air for wing anti-icing only. When wing anti-icing and/or cabin heating and ventilating is not required, a spill system conducts hot air from the muffs overboard. Drain orifices are incorporated in the lowest sections of the muff to disperse any fuel leakage from the jet pipe.

2. Engine Controls

The engine controls increase and decrease the power output of the engine through the power lever control system, start and stop the engine, trim the fuel to the fuel control unit (FCU) for variations of air intake temperature, select



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Exhaust System
Figure 4

positive coarse pitch on the propeller control unit (PCU) for propeller feathering, and arm the fire extinguishing system through the condition lever control system. When each power and condition lever is moved, microswitches in the control pedestal are operated which affect electrical circuits for engine and propeller operation. Other engine controls include oil cooler shutter switches, de-icing and anti-icing switches, ignition and starting system switches and propeller feathering and brake switches.

A. Power Levers

Four power levers are contained within the centrally-mounted pedestal at the flight deck and are connected to the engine control cable system through push-rods, bell-cranks and cable pulleys. Each cable quadrant in the pedestal carries cams which operate the various microswitches for engine and propeller operation. The power lever control system regulates the power output of each engine by controlling the fuel flow and the engine rpm.

Each power lever moves in a slot divided into a flight range and a Beta range. The flight range is used for normal flight operation and the Beta range is used for ground operation. The flight range on the pedestal quadrant is marked FLIGHT IDLE on the minimum flight power stop and FULL POWER on the maximum flight power stop, while the Beta range is detented at max Beta for maximum forward power in the Beta range and is marked GR IDLE on the minimum ground power detent and FULL POWER REVERSE on the maximum ground reverse power stop. A position marked GR RUN is used for sustained engine operation on the ground. Between FLIGHT IDLE and max Beta is a 7° transition range in which there is no control of propeller pitch and, to prevent dwelling in the transition range, the power lever is spring loaded to max Beta when the power lever is lifted clear of the FLIGHT IDLE stop to be moved from the flight range to the Beta range. Movement of the power lever is transmitted to a three-armed lever mounted on the propeller control unit. One arm receives the movement, one relays it to the variable datum of the LP shaft governor, while the third transmits the movement to an external lever on the fuel control unit. The three-armed lever on the propeller control unit is also attached to a lever which transmits power lever movement to a shaft connected to the speed set cam in the propeller control unit. A second arm on the power lever transmits movement to the torquemeter oil system relief valve.

B. Power Lever Friction Lock

The power levers are equipped with a friction locking mechanism to prevent movement of the levers from their selected positions. The mechanism is an integral part of the pedestal and consists of an operating lever linked to a drive nut which is engaged with a pressure shaft. Alternately spaced along the shaft are the power levers and pear-shaped friction plates. The power levers are free to rotate on the shaft, but the friction plates are prevented from rotating by an anchor shaft which runs through a hole in the small dimension of each friction plate.

As the friction lock operating lever is moved forward, the drive nut is rotated and the pressure shaft is screwed into the nut. The shaft is prevented from rotating by a loose fitting peg, thus the nut imparts an axial movement to the pressure shaft. A collar on the shaft applies pressure to the power levers and friction plates, thereby stiffening movement of the levers.

C. Gust Lock and Power Lever Interlock System

The gust lock and power lever interlock system ensures that forward movement of the power levers can be applied to one engine only on each wing when the control surface gust locks are engaged. When the aircraft is on the ground, power is supplied to a solenoid which releases a lock from the gust lock lever system and movement of the gust lock lever to ON brings the power lever interlock mechanism into position.

D. Air/Ground Lever

An air/ground lever, located on the control pedestal, is provided to prevent inadvertent movement of the power levers into the Beta range when the aircraft is airborne. Safety switches on the landing gear automatically operate the air/ground lever to move to the AIR position on lift-off.

Actuation of either safety switch on the landing gear energizes a solenoid, after a 15 second delay, thus releasing the air/ground lever to the AIR position, at which position the lever actuates a microswitch to de-energize the solenoid. Movement of the air/ground lever away from the AIR position during flight energizes the solenoid and prevents permanent selection to the GROUND position. When the air/ground lever is in the AIR position, catch assemblies prevent the power levers from being lifted high enough to clear the FLIGHT IDLE position stop.

Actuation of the safety switches upon landing isolates the solenoid which remains de-energized upon selection of the air/ground lever away from the AIR position. When the air/ground lever is moved back to the GROUND position, it is retained by the solenoid-operated catch and the power levers are free to be placed into the Beta range.

E. Engine Condition Levers

Four engine condition levers are installed on the control pedestal and are connected to the engine control cable system through push-rods and cable pulleys. In addition, each condition lever rotates a cam wheel for engine and propeller microswitch operation. The engine condition lever control system is used for starting and stopping the engines, trimming the fuel flow from the fuel control unit to allow for variations in ambient temperature, selecting positive coarse pitch for propeller feathering, and arming the fire extinguishing system and fluid shut-off system.

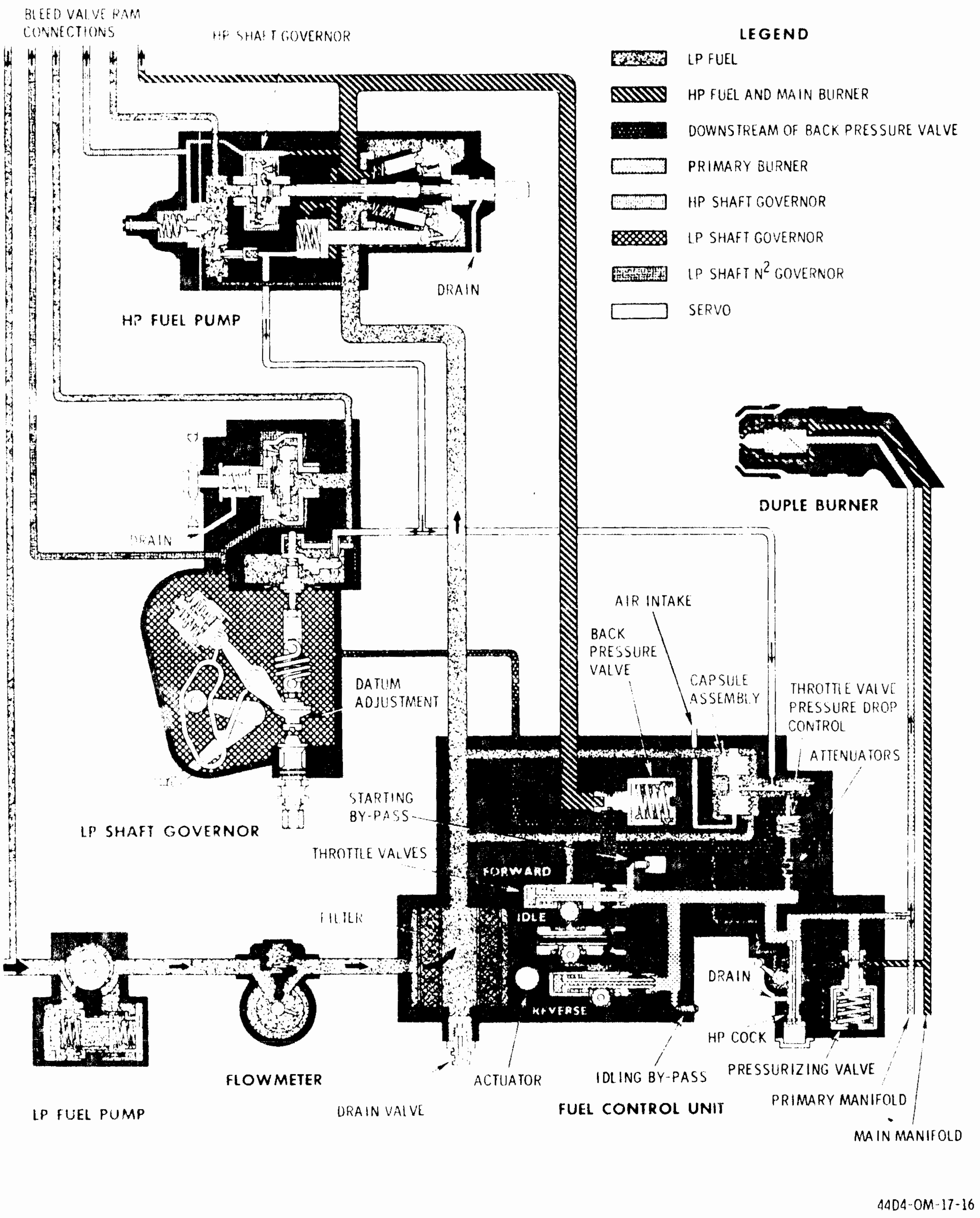
Each engine condition lever moves in a slot in the pedestal quadrant where detents hold the lever in various operating positions. The positions on the quadrant are marked PULL UP TO ARM FIREX, FEATHER, FUEL OFF, START, WEAK, RUN and RICH. Between WEAK and RICH positions, the condition lever engages a segment of closely spaced detents with a ratchet pawl for fine adjustments of fuel flow to the fuel control unit. A graduated scale, which reads from 0 to 50, is illuminated for night flying. Should the engine condition controls jam during an engine emergency, the condition lever can be pulled back to arm the fire extinguishing system with a greater-than-normal-load force.

Movement of the engine condition lever is transmitted from the vertical layshaft push-rod to the feathering selector lever on the propeller control unit. An extension on the selector lever transfers movement to a cam box mounted on the fuel control unit. An arm on the engine condition lever is connected to a cam wheel which operates the various microswitches for engine and propeller control. A warning light in each engine condition lever illuminates in the event of engine failure and/or engine fire. With the engine condition lever at the START position, a microswitch energizes a solenoid which prevents movement of the power lever from GR IDLE.

3. Engine Fuel System (Ref.Fig.5)

The engine fuel system, which is joined to the aircraft fuel system at the aircraft firewall, consists basically of the firewall shut-off valve, the fuel heater, low pressure fuel pump, flowmeter, fuel filter, high pressure fuel pump, fuel control unit (FCU), LP shaft governor and fuel cut-off valve. The system controls the quantity of fuel necessary to give the required engine power output without exceeding the turbine temperature limitations under all operating conditions. Fixed orifice duple burners, fed by the high pressure fuel pump, inject fuel into the flame tubes as an atomized spray.

During normal flight conditions at a fixed air intake pressure, fuel flow is determined by the effective area of the forward throttle valve orifice and fuel pressure difference. The orifice area is varied by manual operation of the throttle valve plunger and the pressure difference is maintained as a constant, irrespective of plunger position, by automatic operation of a servo system. The servo system varies pump stroke and output to match the different engine requirements caused by changes in flight conditions. Fuel pressure used in the servo system is produced by passing fuel from the high pressure pump to the



Engine Fuel System
Figure 5

low pressure side of the fuel system through controlling bleeds in the FCU, the LP shaft governor and the high pressure fuel pump.

The bleed in the FCU is controlled by a pressure drop valve which maintains a constant pressure across the throttle valve for any fixed air intake pressure, and a capsule assembly which, for any given setting of the throttle valve, varies fuel flow with differences in air intake pressure. The bleed in the LP shaft governor controls fuel flow when the engine is operating within the Beta range and, in the flight range, prevents LP compressor overspeeding should the normal propeller control fail. The bleed in the high pressure fuel pump prevents HP compressor overspeeding in the flight range.

A. Operation

Fuel from the aircraft system is drawn through the fuel heater by the low pressure fuel pump and delivered through the flowmeter and filter to the high pressure pump. The output from the high pressure pump is then delivered to the FCU and passes through the back pressure valve to the throttle valves which meter the fuel according to the engine operating conditions. From the throttle valves, the fuel passes through the high pressure cock to the pressurizing valve which proportionately divides the fuel flow between the primary and main burner manifolds.

During normal flight operation, when the forward throttle valve is opened, a decrease in the fuel pressure difference across the valve causes the servo bleed in the FCU to close, producing a rise in the servo pressure and increasing pump stroke and fuel flow to the burners. The pressure drop across the throttle valve then rises and the servo bleed opens, thus stabilizing the throttle valve inlet pressure at the new value. Any change in forward speed or altitude, will effect the servo bleed through the FCU capsule assembly and the fuel flow will be automatically varied to suit engine requirements without change of throttle setting.

Within the Beta range, the setting of the reverse throttle valve gives a fuel flow which always exceeds the amount of fuel required to keep the LP shaft up to the governor setting. The actual flow, however, is determined by the LP shaft governor according to the rpm selected by the power lever position.

During normal operation of the engine, the idling throttle valve is fully open, but when a fuel flow value below that necessary for flight or ground idling is required, such as at engine starting, the valve closes. The fuel flow to the reverse throttle valve is cut off when the idling throttle valve is closed.

B. Fuel Heater

The fuel heater automatically controls the fuel temperature at the low pressure fuel pump inlet to ensure a minimum fuel temperature of approximately +5°C, thus preventing ice formation in the fuel supply to the engine at any point downstream of the fuel heater. This is achieved by directing the fuel through a heat exchanger which is heated by engine scavenge oil. To maintain the oil temperature at a value high enough to ensure adequate fuel heating, the airflow through the oil cooler is determined by the position of the exit flap located in the cooler outlet duct.

Fuel from the aircraft fuel system enters the heater and flows through internal tubes and around a thermostat unit to the outlet connection, from which it is delivered to the low pressure fuel pump. Return oil from the common scavenge pump is delivered to the fuel heater and passes around the outside of the internal tubes to an outlet port. From the outlet the oil is directed to the oil cooler through the four upper air intake struts. A spring-loaded by-pass valve, connecting the oil inlet and outlet ports, opens when the pressure difference exceeds a given value. The by-pass valve can also be opened by a thermostat unit which prevents fuel overheat. The thermostat contains a temperature sensitive wax charge which expands rapidly over a limited temperature range and actuates the valve. Two temperature-sensing units in the fuel heater outlet are connected with the master caution and annunciator panel lights to give indications of excessively high and low fuel temperatures.

C. Flowmeter

The fuel flowmeter system provides a constant indication of the rate of fuel flow to the engine. The flow rate is measured by an engine-mounted transmitter which sends an electrical signal to an indicator on the pilots centre instrument panel. The transmitter consists of two similar cylindrical rotors mounted end-to-end on a common axis within a cylindrical casing. Several equally spaced ducts are machined through each rotor, parallel with the axis of rotation. The rotor adjacent to the fuel inlet is driven at a constant speed by a synchronous motor, and imparts an angular momentum to the fuel proportional to the mass flow through the ducts. This momentum is removed as the fuel passes through the ducts in the second rotor, which is restrained by a spring. The angular position of this rotor, which is a measure of the torque exerted on it in removing the angular momentum of the fuel and therefore a measure of mass flow, is electrically transmitted to the indicator which shows fuel consumption in pounds per hour.

A standby power unit is installed to preclude the possibility of the fuel flow indicating system becoming inoperative in the event of failure of the normal fuel flow indicating power supply system. A power supply selector switch, marked NORMAL-STANDBY, is located adjacent to the fuel flow indicators on the pilots centre instrument panel.

D. Fuel Filter

The low pressure fuel filter is installed upstream of the high pressure fuel pump and prevents foreign particles from entering the high pressure fuel system. Fuel from the flowmeter enters the filter casing and passes from the outside to the centre of the filter element. The filtered fuel then passes upwards into the main casing of the fuel control unit and flows out from the highest point in the unit to the high pressure fuel pump, thus ensuring that any air trapped in the fuel control unit is swept into the fuel pump.

E. High Pressure Fuel Pump

The high pressure fuel pump delivers a controlled supply of fuel to the burners throughout the wide range of fuel flows required by varying engine speeds and altitudes.

The pump consists of a positive displacement multi-plunger variable-stroke pump unit and a hydromechanical overspeed governor. The hydromechanical governor produces a hydraulic pressure proportional to engine speed. This pressure is unaffected by fuel density and is used to control pump stroke through the servo system, thus preventing HP compressor and turbine rotating assembly overspeed.

F. Low Pressure Fuel Pump

An engine-driven rotor-and-vane type low pressure fuel pump is installed downstream of the fuel heater. The low pressure pump is incorporated in the engine fuel system to maintain a sufficiently high fuel pressure at the high pressure pump inlet to prevent cavitation under all normal operating conditions.

The pump casing contains a relief valve to limit pump delivery pressure and a by-pass valve which opens if the pressure from the aircraft fuel system exceeds the output of the low pressure fuel pump.

G. Fuel Control Unit (FCU)

The output from the high pressure pump is delivered to the fuel control unit (FCU) which contains the manual and automatic controls necessary to ensure the correct fuel flow to the engine under all flight conditions. These controls, together with the fuel filter are contained in a casing secured to the forward face of the wheelcase. The FCU consists of the following sub-assemblies:

(1) A back pressure valve which limits the amount of fuel reaching the throttle valves until the high pressure pump delivery pressure is sufficient to ensure rapid operation of the bleed valve ram during transient changes in the high pressure compressor and low pressure compressor shaft speeds. The unit is positioned upstream of the throttle valves and consists of a spring-loaded plunger which opens to

allow fuel flow to the throttle valves when pump delivery reaches a value which is above that required for rapid bleed valve ram actuation. A limited quantity of fuel is allowed to pass the plunger when it is in the closed position to permit the engine to be started at a comparatively low pump pressure.

(2) Three throttle valves, forward, reverse and idling, each of which provides variable restriction of fuel flow to the burners, the controlling restriction and its effective area being selected according to the operating condition required. The forward throttle valve consists of a hollow plunger sliding in a sleeve which is ported to allow fuel to enter the assembly. The plunger is actuated by movement of the power lever. The valve position can also be varied by movement of the fuel trim mechanism.

The reverse throttle valve is similar to the forward throttle valve in both construction and actuation and, though moving throughout the complete power lever range, controls the fuel flow only within the operating range from flight idle to full reverse.

The idling throttle valve consists of a hollow plunger sliding in a sleeve which is ported to allow fuel to pass through the valve. The plunger has no intermediate position and is opened or closed by a timed rotary electric actuator controlled by the engine condition lever. The valve is fully open during normal operation, but closes when a fuel flow below that necessary for flight or ground idling is required. Fuel flow to the reverse throttle valve is discontinued when the idling throttle valve is closed. The opening or closing time of the idling throttle valve is approximately 20 seconds. Indicators on the pilots centre instrument panel show the position of the idling throttle valves: HIGH when open; LOW when closed; diagonal stripes when in transit or de-energized.

(3) A high pressure cock which, when closed, cuts off all fuel to the burners and diverts the fuel flow through ports to the low pressure side of the fuel system. On engine run-down, fuel remaining in the burners and burner manifolds is blown out by combustion chamber pressure to an overboard drain. The high pressure cock is actuated by the engine condition lever.

(4) A pressurizing valve which splits the fuel flow to the burner into a primary and a main flow. As the fuel flow increases, the increase in primary burner pressure progressively opens the valve and regulates the flow to the main burner manifold.

(5) A pressure drop control assembly which maintains a constant pressure drop across the throttle valves at any fixed intake pressure. Any

variation in the pressure drop across the throttle valves will cause the assembly to vary the pump stroke through the servo system, and thus maintain a constant pressure difference.

(6) A capsule assembly whose function is to correct the fuel flow to compensate for changes in altitude or speed. The capsule assembly consists of an evacuated capsule opposed by a similar capsule of equal effective area but subject internally to air intake pressure. The combination of two capsules of equal effective area ensures that variations due to fluctuations in pressure of the low pressure system are eliminated.

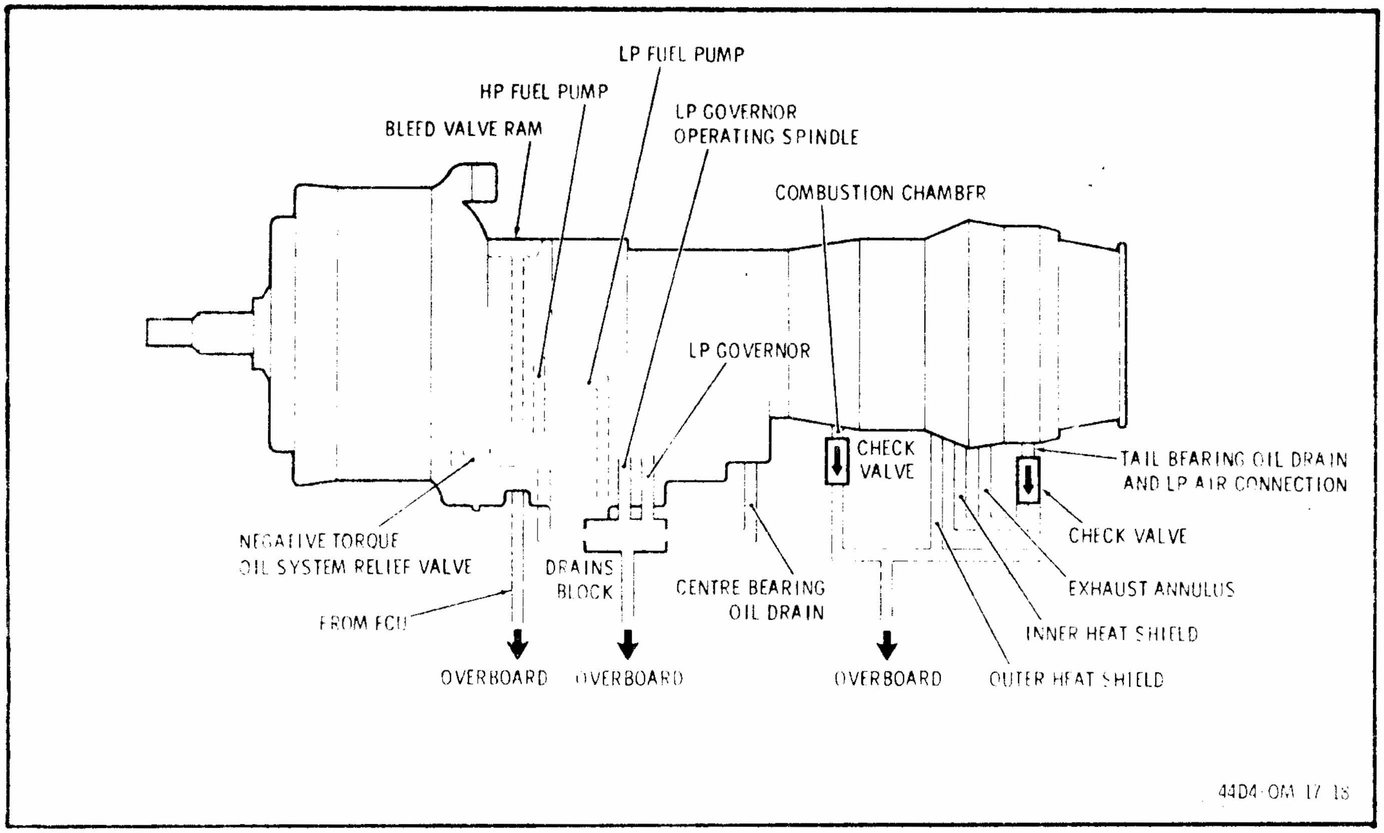
(7) A throttle valve control and a trim mechanism which are connected to the engine control system. Movement of the power lever is transferred through a series of links and levers to the forward and reverse throttle valves. The trim mechanism lever is connected to a shaft which passes through the FCU casing and is linked with a compound lever system. This system varies the effective radius of the lever controlling movement of the forward throttle valve and permits adjustment of the valve setting without movement of the power lever, the arrangement being such that any set trimmer position will apply a constant percentage correction to the fuel flow at all throttle settings. The trimmer position is set by the engine condition lever.

(8) A starting by-pass which provides a permanent bleed across the forward throttle valve and consists of a metering valve in which the orifice is controlled by a preset tapered needle. The fuel flow through this orifice, together with the small flow through the slots in the forward throttle valve, provide the fuel for engine starting.

(9) A flight idling by-pass which is preset to provide a bleed across the reverse throttle valve when the idling throttle valve is open. This bypass is used to set flight idling fuel flow during initial calibration.

H. LP Shaft Governor

The LP shaft governor controls the fuel flow to the engine at all power lever positions within the Beta range and functions as an overspeed governor in the flight range. The unit produces a hydraulic pressure which is proportional to engine rpm and is unaffected by fuel density or viscosity. This pressure, together with a mechanism to vary the governor setting, is used to control pump stroke and hence fuel flow. LP shaft governor pressure is also applied to the bleed valve ram to provide a signal which, together with a signal from the high pressure pump rpm governor, controls the operation of the bleed valve.



Fuel Drainage System
Figure 6

I. Fuel Cut-off Valve

The fuel cut-off valve is housed in a connection between the fuel supply from the FCU and the burner manifolds to make provision for fitting a turbine overspeed system.

J. Fuel Drainage System (Ref.Fig.6)

A fuel drainage system is provided to reduce fire risks by collecting and disposing of any unburnt fuel which may escape from the engine or through the seals of fuel-operated units. Interconnected with the system are the oil drains from the centre and turbine rear bearings and the torquemeter relief valve. A drains block mounted on the right-hand wheelcase receives fuel drainage via external pipes from the low pressure and high pressure fuel pumps, the LP shaft governor and the LP shaft governor operating spindle. Pipes from the compressor bleed valve ram fuel drain and the torquemeter relief valve oil drain lead to a common connection on the high pressure fuel pump casing. This connection also receives the drainage from between the seals of the pump rotor drive-shaft, and the combined drainage is conveyed to the drains block. The drains block also receives oil drainage from the centre bearing and the combined drainage from all units is dumped overboard through a single external pipe from the block, known as the telltale drain. Under normal circumstances, there is always a slight seepage from this drain, but any definite leakage indicates a seal failure in one of the units and must be investigated.

When the engine is stopped by closing the high pressure fuel cock, any fuel remaining in the burner manifolds is blown by combustion chamber pressure through the high pressure fuel cock assembly and passes through internal passages to an external union on the fuel control unit body and a pipe from this union conveys the fuel overboard. In the event of an engine failing to start, provision is made to drain away unburnt fuel in the combustion chamber, nozzle box, tail bearing housing and engine exhaust unit. Spring-loaded non-return valve assemblies control the drainage from the combustion chambers and also the common drain which serves the nozzle box, tail bearing housing and jet pipe. The non-return valve assemblies are interconnected by an external pipe and the combined drainage is piped overboard through a connection on the nozzle box and tail bearing housing drain valve assembly.

A union in the forward section of the jet pipe allows unburnt fuel in the pipe to drain into a sump in the fire tunnel. Fuel leakage through the jet pipe is collected in a drip tray welded to the ventilating air distribution ring and drains into the sump, the combined drainage being piped overboard.

K. Power Sources

The circuit-breakers and power sources for the engine fuel system are as follows:

	Quantity
(1) Constant-frequency A.C. Bus A	
Fuel Flowmeter Indicators Nos 1, 2, 3, 4	4
(2) D.C. Essential Bus - Panel A	
Idling Throttle Valves Nos 1, 2, 3, 4	4
(3) D.C. Essential Bus - Panel B	
Fuel Flowmeter Power Normal	1
Fuel Flowmeter Power Standby	1
Engine Fuel Temperature Warning Nos 1, 2, 3, 4	4

4. Engine Starting System

Compressed air supplied from an external source through a ground-air inlet valve, located just aft of the nose compartment on the port side of the aircraft, is ducted to an air starter motor on each engine. From the external source, the air is ducted, at 37 (± 3) psi pressure, along the port side of the fuselage to a point just aft of the wing leading edge. At this point, the air manifold branches into two ducts, one passing along the front spar on the port side to supply air to the starter motors on the port engines and the other passing to the starboard side to supply air to the starter motors on the starboard engines.

The air starter motor is contained in a casing secured to the right-hand wheel-case input shaft and is used to turn the HP compressor shaft assembly during engine starting. The air supply is controlled by a solenoid-operated shut-valve which admits air to the starter turbine blades when cranking is initiated.

On aircraft equipped with the soft start valve modification, a valve installed in the nose bay permits the air start ducting to be vented overboard. With the external air source connected to the aircraft, the compressed air is continually bled overboard until a "start" selection is made. At this point the starter valve opens and the soft valve gradually closes progressively increasing the supply of compressed air to the starter motor. On completion of the start cycle, the soft start valve again opens, bleeding the compressed air to atmosphere.

A. Controls

Switches on the pilots overhead panel and a centrifugal switch on the air starter control engine cranking and engine ignition. Selection of the engine to be cranked is made by a rotary switch with OFF, 1, 2, 3, 4 and ALL positions. An engine start switch marked CRANK-OFF-START control of the operation of the air starter. A centrifugal switch operates to interrupt the circuit when the HP compressor shaft attains 5500 rpm (31.2% rpm).

Aircraft fitted with the D.C. start system have an additional inverter fitted which supplies A.C. power to the T.G.T. indicators permitting a #2 engine start when only D.C. ground power or battery power available.

B. Operation

With the engine to be cranked selected on the engine selector switch, the circuit is armed for engine cranking. Placing the engine start switch to either START or CRANK energizes the solenoid at the shut-off valve. This causes the control valve to open and permit starting system air to operate the starter motor. At starter speed equivalent to 5500 (31.2%) HP compressor shaft rpm, the centrifugal switch opens and interrupts the electrical supply to the solenoid. The control valve closes and cuts off the air supply to the starter motor. With the start valved fitted, the soft start valve is sequenced with the starter valve.

C. Power Sources

The power sources and circuit-breakers for the starting and ignition systems are as follows:

(1) D.C. Main Bus	Quantity
Ignition Booster No. 2	1

(2) D.C. Essential Bus - Panel A

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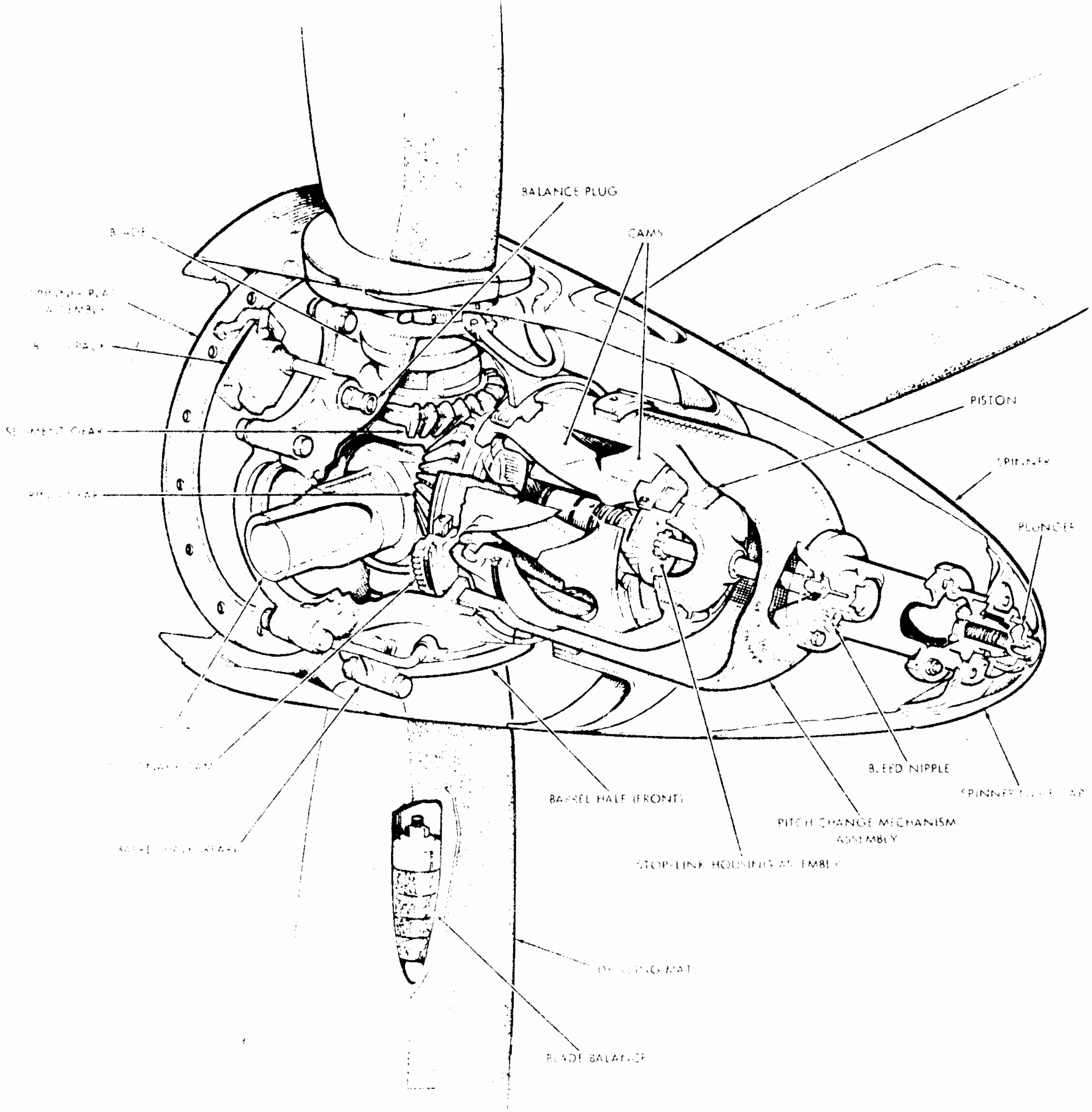


Propeller - Cutaway
Figure 7

	Quantity
Engine Ignition and Start - Start	1
Engine Ignition and Start - Ignition Booster No. 1	1

5. Ignition System

The ignition system is only required during ground starting of the engines and relighting in flight. Under normal operating conditions, fuel combustion is self-sustaining. The ignition system for each engine consists of two high-energy ignition units, two igniter plugs, screened high tension leads and low tension leads.

The two high-energy ignition units are located on the engine firewall and are connected to the igniter plugs in No. 3 and No. 8 flame tubes by screened cables. When the ignition system is energized, the units transform the 28-volt d.c. supply to a high voltage discharge at the igniter plugs at a frequency of one or two discharges per second. The igniter plugs are of the high-energy surface discharge type, each having a body of heat resistant steel and incorporating a semi-conducting material between the electrodes for initial ionization before the discharge.

A. Ignition Controls

The power supply to the ignition units is controlled by the engine start switch, the engine selector switch and the engine condition lever microswitches. An Emergency Relite switch, located on the pilot's overhead panel, is installed to provide continuous ignition during takeoff and landing on water and slush covered runways. A warning light above this switch indicates when the switch is in the "ON" position.

B. Ignition System Operation

With the engine condition lever in the START position and the engine selector switch at the appropriate engine, the two high-energy ignition units are energized when the engine start switch is placed to START.

When the engine selector switch is placed to ALL, two relays are energized to supply power to all the ignition units simultaneously when the engine start switch is placed to START. The ignition system is not energized when the engine start switch is placed to the CRANK position. The Emergency Relite switch, which is connected in parallel with the engine start switch, energizes the ignition units of all engines when the switch is placed "ON", provided the engine condition levers are placed to "START" or above, and the engine selector switch is selected to "ALL".

6. Propellers (Ref.Fig.7)

Four Type PD-228/476/2 deHavilland constant-speed hydromatic propellers

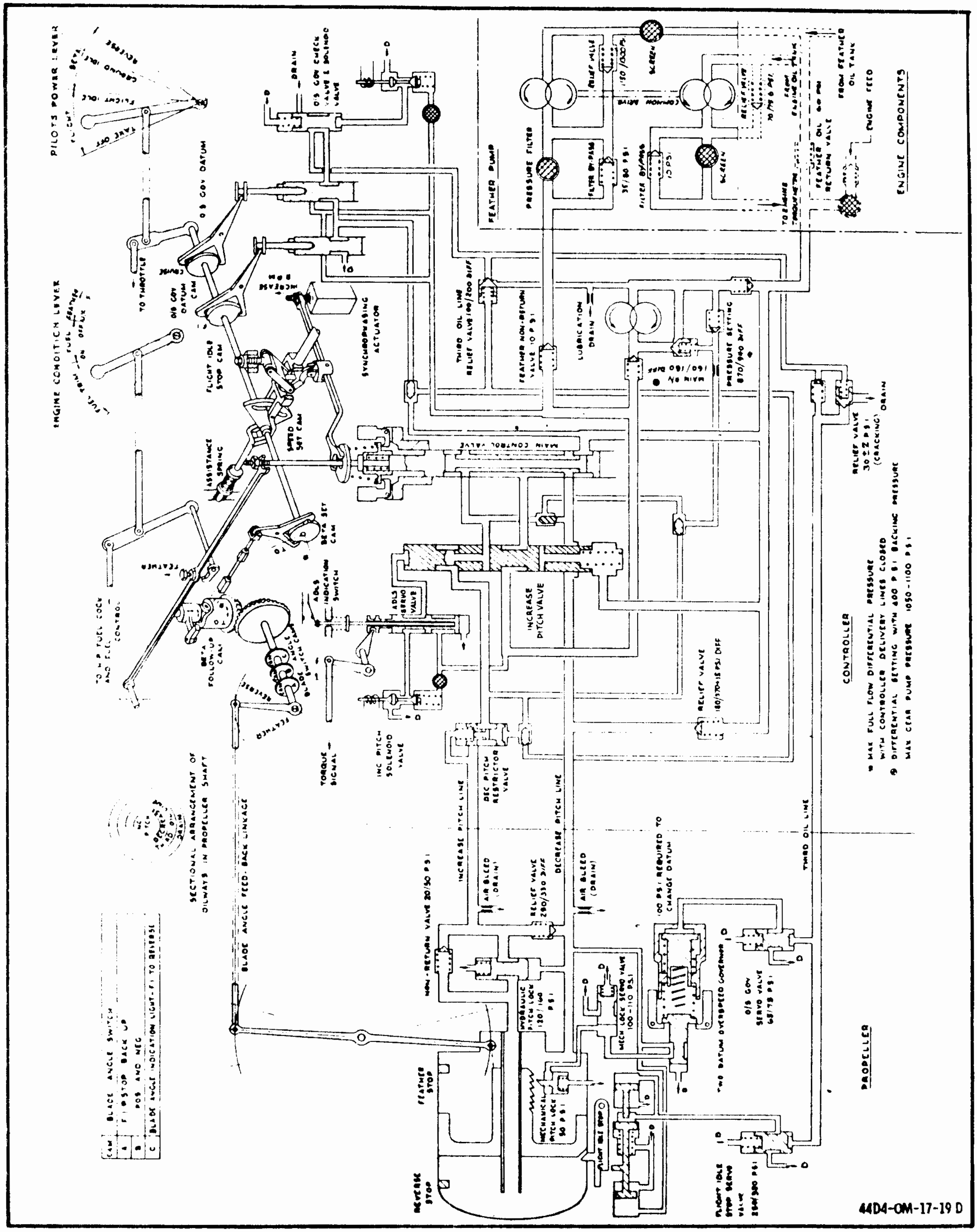

PILOTS POWER LEVER
TAKE OFF
FLIGHT IDLE
GROUND IDLE
REVERSE
BETA
ENGINE CONDITION LEVER
FUEL TRIM
FUEL ENRICH
ON DEFLUX
O/S GOV DATUM
TO THROTTLE
CRUISE
O/S GOV DATUM CAM
FLIGHT IDLE STOP CAM
INCREASE RPM
SYNCHROPHASING ACTUATOR
ASSISTANCE SPRING
SPEED SET CAM
BETA SET CAM
FEATHER
TO H P FUEL COCK AND FLEX CONTROL
BETA FOLLOW-UP CAM
BLADE ANGLE SWITCH CAM
ADLS INDICATION SWITCH
ADLS SERVO VALVE
REVERSE
FEATHER
TORQUE SIGNAL
INC PITCH SOLENOID VALVE
SECTIONAL ARRANGEMENT OF OILWAYS IN PROPELLER SHAFT
BLADE ANGLE FEED-BACK LINKAGE
CAM | A | BLADE ANGLE SWITCH
A | F/I STOP BACK UP
B | POS AND NEG
C | BLADE ANGLE INDICATION LIGHT-F/I TO REVERSE
DRAIN
O/S GOV CHECK VALVE & SOLENOID VALVE
D
ID
FEATHER PUMP
PRESSURE FILTER
RELIEF VALVE
130/150 PSI
SCREEN
FILTER BY-PASS
35/50 PSI
COMMON DRIVE
FILTER BY-PASS 10 PSI
SCREEN
RELIEF VALVE 70/75 D PSI
FROM ENGINE OIL TANK
FEATHER OIL RETURN VALVE
FROM FEATHER OIL TANK
ENGINE FEED
TO ENGINE
ENGINE COMPONENTS
THIRD OIL LINE RELIEF VALVE 180/200 DIFF
FEATHER NON-RETURN VALVE 10 PSI
LUBRICATION DRAIN
MAIN N/R 160/180 DIFF *
PRESSURE SETTING 870/940 DIFF ⊕
RELIEF VALVE 30 ± 2 PSI (CRACKING)
DRAIN
MAIN CONTROL VALVE
INCREASE PITCH VALVE
RELIEF VALVE 180/370 ± 15 PSI DIFF
CONTROLLER
* MAX FULL FLOW DIFFERENTIAL PRESSURE WITH CONTROLLER DELIVERY LINES CLOSED
⊕ DIFFERENTIAL SETTING WITH 400 PSI BACKING PRESSURE
MAX GEAR PUMP PRESSURE 1050-1100 PSI
DEC PITCH RESTRICTOR VALVE
INCREASE PITCH LINE
DECREASE PITCH LINE
AIR BLEED (DRAIN)
RELIEF VALVE 290/330 DIFF
AIR BLEED (DRAIN)
100 PSI REQUIRED TO CHANGE DATUM
THIRD OIL LINE
NON-RETURN VALVE 20/50 PSI
HYDRAULIC PITCH LOCK 120/140 PSI
MECH LOCK SERVO VALVE 100-110 PSI
TWO DATUM OVERSPEED GOVERNOR
O/S GOV SERVO VALVE 68/78 PSI
FEATHER STOP
MECHANICAL PITCH LOCK 50 PSI
FLIGHT IDLE STOP
REVERSE STOP
FLIGHT IDLE STOP SERVO VALVE 280/300 PSI
PROPELLER
44D4-OM-17-19 D

Figure 8

are installed on the aircraft. The propellers are 16 feet (+0. 14, -1. 00 inches) in diameter and each consists of four solid light alloy blades in a steel hub. Electrically heated anti-icing mats on the spinner and elements on the blades are operated intermittently through a cyclic timer (Ref.Sect.13).

The propeller system provides normal constant-speed operation in all flight conditions and blade angle and also provides Beta control for reverse pitch operation and ground handling. The propeller control unit (PCU) governs propeller speed in the pitch range from feathered to flight idle. This range is separated from that of the Beta control by a mechanical stop in the propeller. At blade angles below this stop, the PCU ceases to govern rpm and is used as a follow-up servo to control blade angle through a mechanical feed-back mechanism from the propeller blades. The range from flight idle to full reverse is known as the Beta range. The PCU is connected to the fuel control unit (FCU) so that the rpm is dependent upon fuel flow scheduled by the power lever. Protective features of the propeller system include an automatic drag limiting system (ADLS), a pressure sensitive hydraulic pitch lock, an overspeed sensitive mechanical pitch lock, a mechanical flight idle stop, a secondary safety stop, a Beta control stop and propeller feathering.

A. Operation

Oil at engine feed pressure is drawn from the filter in the air intake casing, through the LP compressor front bearing panel and No.3 strut of the intake casing, to the pump in the PCU. (Ref.Fig.8.) The PCU pump boosts the oil pressure to a value determined by the relief valve and the oil is directed to three feeds which carry coarse pitch, fine pitch and third line oil to the propeller pitch change mechanism.

The position of the main control valve in the PCU, and hence the direction of the oil flow, is determined by the centrifugal force of the governor weights acting on the valve. At the controlling position, overspeeding is prevented by increasing the oil supply to the coarse pitch line. This moves the blade-operating piston to coarsen the pitch, while the oil from the other side of the piston is returned to the governor pump. Similarly, underspeeding is prevented by increasing the oil supply to the fine pitch line. The value of rpm at which the propeller is governed is varied by the position of the power lever which selects fuel flow and rpm according to a predetermined relationship.

When the air/ground lever on the pedestal is moved to the ground position upon landing, the power lever can be lifted and moved below the flight idle position. Initial movement of the power lever below FLIGHT IDLE resets the LP shaft governor to a lower rpm setting, actuates the reverse throttle valve, withdraws the flight fine pitch stop, and selects a blade angle which is 2° lower than the flight idling blade angle by means of the feed-back mechanism. The flight idle stop is withdrawn by the flight idle stop cam which operates a valve, allowing oil from the PCU pump into the third oil line. The speed set cam overrides the PCU governor so that movement of the power lever raises or lowers the PCU main control valve. As the blades respond to the resulting flow of oil in either the increased or decreased pitch direction, the blade angle feed-back mechanism restores the PCU main control valve to neutral and pitch changing ceases when the angle selected by the power lever is reached.

B. Automatic Drag Limiting System (ADLS)

The automatic drag limiting system (ADLS) provides auto-initiated pitch coarsening of the propeller blades to a near feathered position. The ADLS is actuated by movement of the annulus gear in the propeller reduction gear, which is designed so that such movement takes place at a predetermined torque level in the propeller shaft, this torque level being varied according to power lever position. Movement of the annulus gear is transmitted by a mechanical linkage to a servo valve which operates the increase pitch valve in the PCU. The increase pitch valve cuts out the normal governor control from the propeller and couples the PCU pump output directly to the increase pitch line, thus providing automatic feathering in all cruise and take-off power lever positions and eliminating the possibility of excessive drag in the event of engine failure or propeller malfunction.

The power lever position controls the setting of a variable datum relief valve in the oil delivery line from the torquemeter pump to the negative torque master cylinder. The setting of the relief valve is controlled from a positive value during most of the flight range to a negative value in the range from just above FLIGHT IDLE to GROUND IDLE. The negative value permits the necessary approach and landing drag to be obtained without ADLS initiation. A microswitch in the PCU closes to illuminate warning lights when the ADLS operates.

C. Hydraulic Pitch Lock

A hydraulic pitch lock installed in the system automatically closes and traps oil in the coarse pitch side of the pitch change mechanism in the event of an interruption of the oil supply to the controller, failure of the drive, loss of increase pitch, or decrease pitch pressure. A shuttle valve in the increase pitch line is held open by decrease pitch line pressure and, when this falls, the valve closes and prevents the blades from moving towards fine pitch. A non-return valve in the increase pitch line by-passes the hydraulic pitch lock and permits propeller feathering when the lock is engaged.

D. Mechanical Pitch Lock

A mechanical pitch lock in the pitch change mechanism engages under conditions of overspeed or loss of oil pressure and prevents any further movement of the blades into finer pitch. A ratchet in the lock mechanism permits propeller feathering when the mechanical pitch lock is engaged. The spring-loaded piston of the pitch lock is normally held out of engagement by oil pressure, so that loss of oil pressure will allow the lock to engage. Under overspeed conditions, a centrifugal-type overspeed governor in the PCU operates a spring-loaded valve which cuts off pressure from the pitch lock piston and allows the pitch lock to engage. The overspeed governor is set to operate at a low setting which is 5% above cruising rpm and a high setting which is 5% above maximum rpm. As the power lever is advanced beyond the cruising position, a cam mechanism raises a valve to allow high pressure oil to the back of a piston in the overspeed governor. Movement of the piston brings a second spring into effect so that the governor will not allow the pitch lock to engage until the higher rpm is reached.

To check the pitch lock operation, the propeller must be run at a speed greater than the low setting of the overspeed governor. A test circuit in the propeller system enables this condition to be met and consists of a solenoid in the PCU controlled by a two-position switch on the pilots overhead panel. When the test switch is placed to ON and the appropriate engine selected on the engine selector switch, a solenoid-operated valve and a test valve in the PCU connect the back of the overspeed governor piston to drain, through the overspeed governor servo valve, thus selecting a low setting on the governor. With the power lever above the cruise condition, the propeller rpm will then be above the setting of the overspeed governor and an overspeed condition will be simulated, causing the pitch lock to engage. In this condition, it can be determined that the mechanical pitch lock has engaged by moving the engine condition lever toward TRIM LEAN and noting a drop in rpm.

E. Beta Control Stop

The feedback and pitch selection system used for operation in the Beta range is also used in the normal flight range to select a positive blade angle. The blade angle selected is always below the minimum normal blade angle reached in the flight range and does not interfere with normal governing, but provides a hydraulic stop in the event of mechanical pitch lock and/or hydraulic pitch lock failure which tends to turn the blades towards fine pitch.

F. Flight Idle Stop

The flight idle stop is located within the pitch change mechanism and consists of latches which engage on a stop ring to provide a positive limit to travel of the pitch change piston in the fine pitch direction and prevent the propeller blades from moving into the Beta range during flight. When the power lever is moved into the Beta range segment of the pedestal quadrant, a cam follower mechanism lifts a valve in the PCU and allows oil pressure to withdraw the flight idle stop, thus permitting operation of the propeller in the Beta range.

G. DELETED

H. Feathering System

To manually feather the propeller, the engine condition lever is moved to the FEATHER position. This action lifts the main control valve in the PCU to a positive coarse pitch selection and oil, at controller pump pressure, is directed to the pitch change mechanism to turn the blades to the feathered position. Also, when the condition lever is moved to FEATHER, microswitches close to energize the PCU coarse switch solenoid. The PCU pump pressure is supplemented by pressure from an electrically operated feathering pump. With the engine condition lever in the FEATHER position, a microswitch energizes a feathering pump power relay from the main 28-volt d.c. bus, connecting a.c. power to the feathering pump motor. Time switches on No. 2 and No. 3 relay panels stop the feathering pumps at the completion of the propeller feathering operation. Oil for the feathering pump is drawn directly from the feathering oil compartment of the engine oil tank. The feathering system remains operative when the engine condition lever is lifted to the fire extinguisher arming position.

The feathering pump can also be started by controls on the pilots overhead panel consisting of an engine selector switch and a feathering pump switch. These controls are used for unfeathering the propeller or for emergency operation of the feathering pump should the switch on the engine condition lever fail to operate. When an engine is selected on the selector switch and the feathering pump switch is placed to ON, the appropriate feathering pump power relay is energized from the 28-volt d.c. bus.

I. Unfeathering

Movement of the engine condition lever from the FEATHER position releases the main control valve in the PCU and the valve assumes the fine pitch position. When the feathering pump is started, the main control valve directs the oil to the propeller, moving the pitch change mechanism piston away from the feathered position. The oil pressure holds both the mechanical and hydraulic pitch stops open and, when adequate rpm is reached, the feathering pump switch is released and the PCU resumes control of rpm and pitch. A tandem pump is also driven by the feathering motor to pressurize the torquemeter to prevent operation of the ADLS during the unfeathering operation.

J. SYNCHRONIZING SYSTEM

A propeller synchroscope on No. 3 engine is used as the master reference and the slave propellers are controlled individually by comparison with this master.

K DELETED

L DELETED

M. Propeller Reversing

Propeller reversing is achieved by lifting the power levers up and over a gate into the Beta range and past the GROUND IDLE position. Within the Beta range, rpm is dictated by the LP shaft governor and is no longer controlled by the PCU. The LP shaft governor incorporates a variable datum mechanism to provide an engine speed range from 69% to 84.2% LP rpm (10,600 to 12,800 LP rpm) and regulate the fuel supply to the FCU. The resulting power and blade angle are co-ordinated under the control of the power lever to obtain the desired reverse thrust.

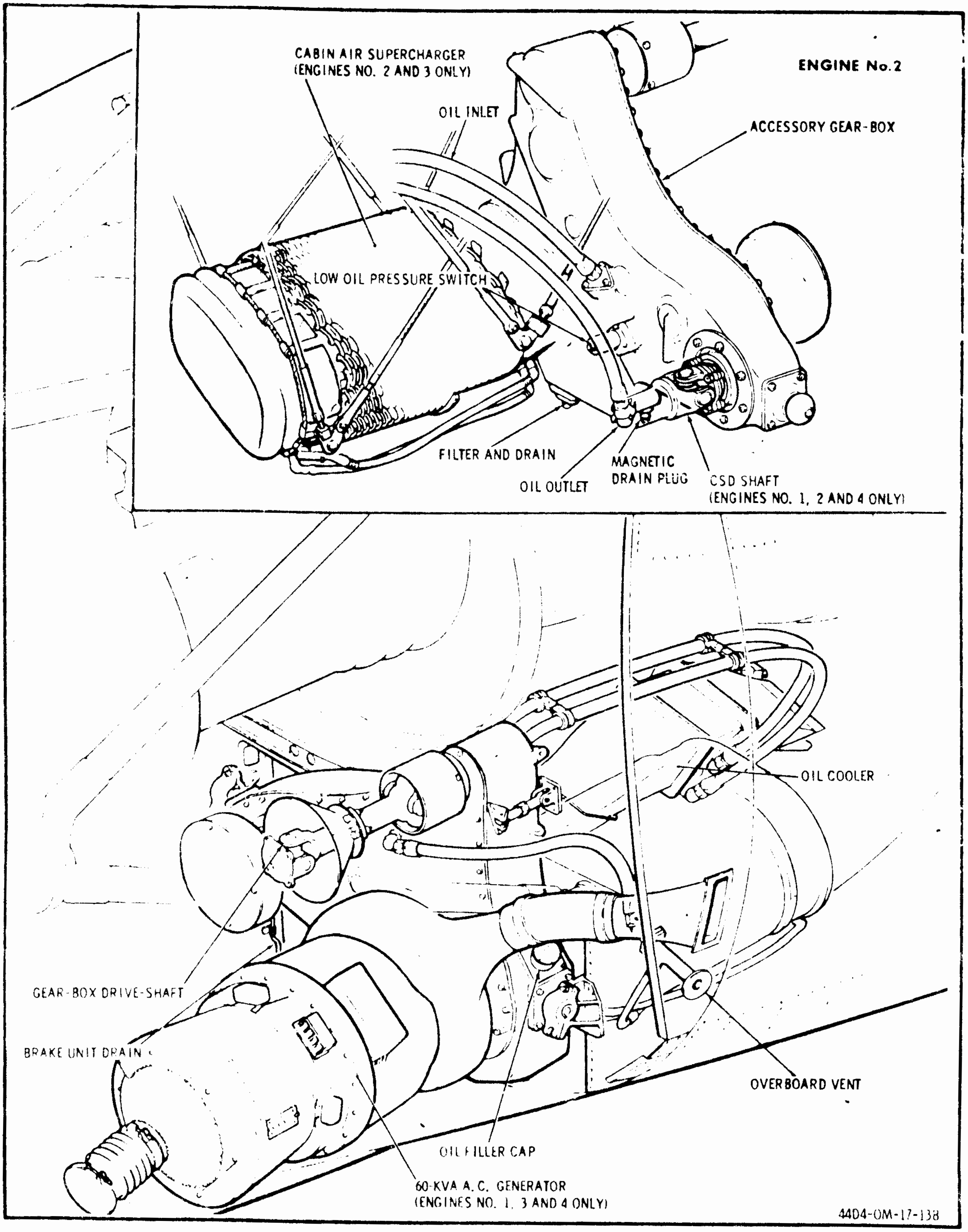
N. Dead Engine Warning Lights

When the ADLS operates, a microswitch in the PCU energizes a circuit from the 28-volt d.c. system, lighting ENGINE FAIL warning lights on the pilots and co-pilots annunciator panels, red master warning lights at the pilots, co-pilots and systems operators stations and a warning light in the engine condition lever.

O. Power Sources

The power sources and circuit-breakers for the propeller system are as follows:

(1) Constant-frequency A.C. Bus A	Quantity
Prop Feather Pump - No. 1 Engine	3
Prop Feather Pump - No. 4 Engine	3
DELETED	
(2) Constant-Frequency A.C. Bus B	
Prop Feather Pump - No. 2 Engine	3
Prop Feather Pump - No. 3 Engine	3



Accessory Gear-box and Drives
Figure 9

		Quantity
(3)	D.C. Main Bus	
	Propeller Control - Pitch Lock Test	1
	Propeller Control - Synchrophasing Control	1
	DELETED	
	Propeller Control - Feather Pump/Condition Lever Nos 1,2,3,4	4
	Propeller Control - Engine Selector Switch	1
(4)	D.C. Essential Bus - Panel A	
	Engine Fail and Beta Range Warning Lights - Engine Nos 1, 2, 3, 4	4
	Engine Fail and Beta Range Warning Lights - Condition Lever	1

7. Accessory Gear-box (Ref.Fig.9)

Each power plant incorporates an accessory gear-box mounted on the forward face of the engine firewall. The accessory gear-box is driven by the low pressure compressor wheelcase. Mounting pads are provided on each gear-box for a 60-kva variable-frequency a.c. generator, a cabin air supercharger and a constant speed drive (CSD) drive-shaft. A cabin air supercharger emergency disconnect is also provided with the accessory gear-box drive.

The accessory gear-boxes are interchangeable between engine positions and blanking plates are provided for accessory mounting pads which are not in use. The accessories driven by each gear-box are as follows:

(1)	No.1 engine accessory gear-box	CSD and 60-kva variable-frequency a.c. generator.
(2)	No.2 engine accessory gear-box	CSD and cabin air supercharger.
(3)	No.3 engine accessory gear-box	60-kva variable-frequency a.c. generator and cabin air supercharger.
(4)	No.4 engine accessory gear-box	CSD and 60-kva variable-frequency a.c. generator.

A. Accessory Gear-box Oil System

The wet-sump type oil system in each accessory gear-box lubricates all internal gears and bearings in the gear-box and also supplies oil for the cabin air supercharger lubrication requirements on engines No.2 and No. 3. The oil sump is formed by the lower section of the gear-box casing. The oil is pressurized by the gear-box pump and circulated to the external cooling system. A relief valve, preset during assembly, maintains constant oil pressure. A pressure filter by-pass valve ensures continued circulation of lubricating oil through the gear-box system should the filter become clogged.

The accessory gear-box oil cooler is mounted on the lower section of the aircraft firewall. Cooling airflow for the oil cooler is supplied via a scoop intake located on the hinged fairing in zone 1A of the power plant. An ejector cooling system is incorporated to improve cooling efficiency during engine ground operation by ducting compressor interstage bleed valve air to the oil cooler air outlet, thus inducing a cooling air flow across the cooler matrix.

B. Accessory Gear-box Low Oil Pressure Warning

The low oil pressure warning switch on the accessory gear-box cover is diaphragm operated and closes an electrical circuit when the oil pressure falls below 20 (± 1) psi. Loss of oil pressure is indicated by the master caution lights and the annunciator panel lights.

C. Cabin Air Supercharger Emergency Disconnect

A hydraulically operated spring-loaded emergency disconnect mechanism is installed with the accessory gear-box drive to the cabin supercharger. The disconnect mechanism consists of a cutting disc actuated by the aircraft 3000 psi hydraulic system. A solenoid-operated normally closed valve mounted on the forward face of the engine firewall is energized to open by a supercharger disconnect switch, marked SPILL-NORMAL-DISCONNECT, located on the systems operators lower panel. With the valve in the open position, pressure from the aircraft hydraulic system is applied to the cutting mechanism and the cutting disc is held against the cabin air supercharger drive-shaft shear neck.

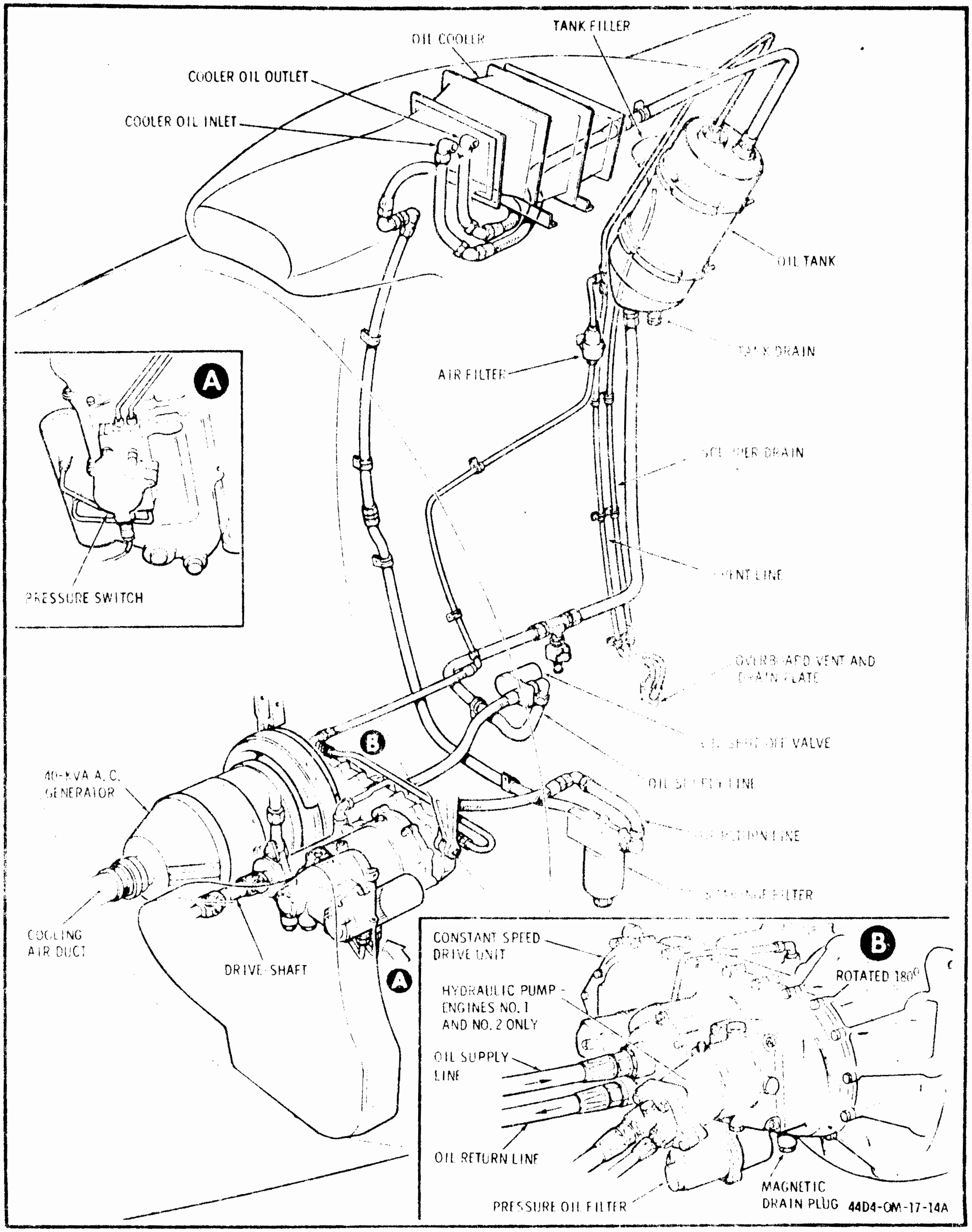
The disconnect mechanism is operated in emergency only to ensure positive disengagement of the cabin air supercharger from the engine. Operation of the disconnect mechanism necessitates the installation of a new blower drive quill.

D. DELETED

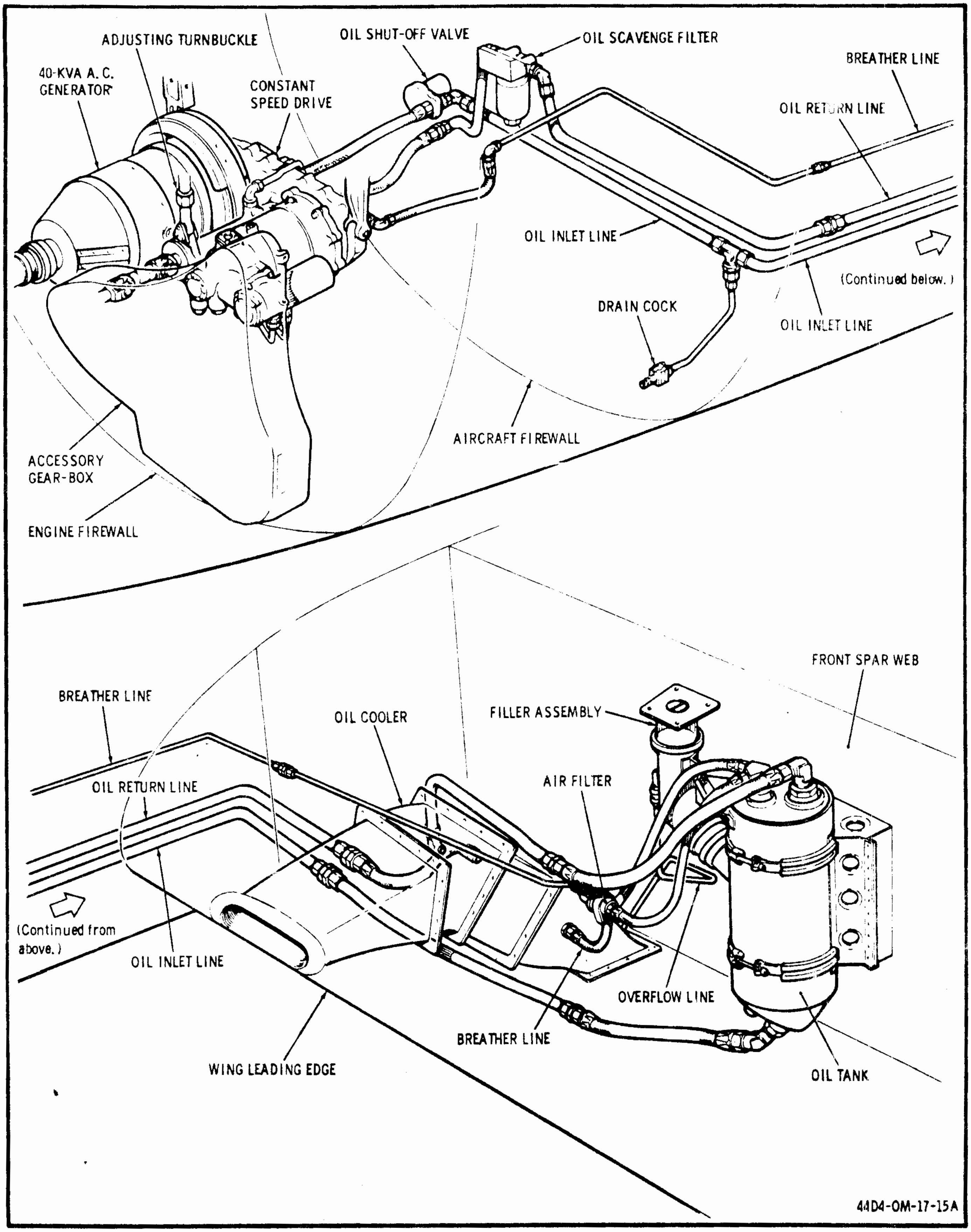
E. DELETED

F. Constant Speed Drive (CSD) (Ref.Fig.10)

A constant speed drive (CSD) is installed on the underside of the horizontal firewall in the accessory section of Nos 1,2 and 4 power plants. The CSD, which is driven from the accessory gear-box by a short interconnecting drive-shaft, is a mechanical-hydraulic transmission type and consists basically of a variable-displacement axial-piston hydraulic pump, a fixed-



Constant Speed Drive (CSD) - Engines No. 1 and No. 4
Figure 10 (1 of 2)



Constant Speed Drive (CSD) - Engine No. 2
Figure 10 (2 of 2)

displacement axial-piston hydraulic motor and a fail-safe governor. The CSD in each of No.1 and No.2 power plants drives a 40-kva constant-frequency a.c. generator and a hydraulic pump while the CSD in No.4 power plant drives a 40-kva constant-frequency a.c. generator only.

At engine speeds varying between approximately 55% and 100% LP rpm, the automatic speed-controlling function of the CSD provides a constant speed of 6000 rpm at the 40-kva generator mounting pad and a constant speed of 4123 rpm at the hydraulic pump mounting pad. A pressure switch is incorporated in the CSD assembly and operates automatically to make and break the electric circuit between the 40-kva generator and the aircraft constant-frequency a.c. system as a function of the CSD input and output speeds.

The fail-safe characteristics of the CSD governor ensures that, in the event of mechanical failure of the governor, output speed of the CSD will be maintained at the minimum value for all input speeds.

G. CSD Oil System

The CSD charge and lubrication oil requirements are supplied by a separate oil system for each CSD installation. The oil is pressurized and circulated by a start pump, a charge pump and a scavenge pump, all of which are integral with the CSD assembly. The CSD oil cooler incorporates thermostatically controlled shutters which function automatically to regulate air flow through the cooler and maintain the CSD oil at the required temperature. In the event of failure of the shutter position linkage or of the thermostat, the shutters will assume the fully open position.

H. CSD Oil Shut-off Valve

The CSD oil shut-off valve is an electrically operated gate valve located in the oil supply line to the CSD. The valve, normally open, is controlled by its associated engine condition lever and closes when the latter is placed to the PULL TO ARM FIREX position.

I. CSD Pressure Switch

The pressure switch, which is hydraulically operated, is sensitive to the variations in CSD charge oil pressure occurring in the governor oil outlet ducts as a result of increase and decreases in CSD input and output speeds. The switch is maintained in the open position by spring pressure and is actuated to close by oil pressure when engine speed exceeds 54 (±0.6)% LP rpm. The switch remains closed at all conditions of normal CSD operating speed and generator load but opens on engine shut-down, engine overspeed or as a result of failure of the CSD transmission. When the CSD pressure switch is in the closed position, the electrical circuit initiates a sequence of operation which connects the 40-kva constant-frequency a.c. generator to the load bus.

J. Power Sources

Circuit-breakers and power sources affecting the accessory gear-boxes and CSD assemblies are as follows:

(1) D.C. Essential Bus - Panel A	Quantity
Engine Gear Box Oil - Low Pressure Warning Nos 1,2,3,4	4
Engine Fire Control - Services Nos 1,2,3,4 (CSD oil shut-off valve)	4

(2) D.C. Essential Bus - Panel B	
Air Cond Supercharger - Control and Overheat Light - LH and RH	2

8. Aircraft Fuel System (Ref.Fig.11)

The aircraft fuel system, which is sub-divided into a main system and an auxiliary system, consists of six integral tanks in the wing and one flexible multiple-cell tank installed in the centre wing area. The main and auxiliary tanks are interconnected by a common manifold, permitting single-point pressure fuelling and defuelling, cross-feeding and fuel transfer. Included in the fuel system are booster pumps, selector valves, shut-off valves, fuel contents indicators and fuel low pressure warning lights.

Auxiliary fuel is utilized to supplement depleted fuel in the main tanks, but may also be supplied directly to the engine fuel system. Provision is made for gravity fuelling and fuel dumping. The fuel supply for the empennage anti-icing heaters is provided by the No.3 main tank booster pump.

During normal operating conditions, each engine is fed from its associated tank and the manifold system is completely isolated during this phase of fuel management. Fuel is delivered from the tank via the booster pump, selector valve, and firewall shut-off valve to the fuel heater, low pressure fuel pump, flowmeter and high pressure pump of the engine fuel system (Ref.Sect.2).

A. Fuel Tanks

The fuel is carried in four main and three auxiliary tanks. The four main integral tanks are numbered 1,2,3 and 4 from port to starboard in accordance with the engines they supply under normal operating conditions. Auxiliary integral tanks 5 and 7, also numbered from port to starboard, are installed outboard of the main tanks. Six flexible fuel cells are interconnected to form the centre auxiliary tank which is tank No.6. The main and auxiliary tanks are connected by a common manifold which permits cross-feeding any engine or engines from any main tank or combination of main tanks and fuel transfer from any tank or combination of tanks to any other tank. For location of fuel drains, refer to Figure 12.

B. Operating Controls and Indicators

Management of the aircraft fuel system, except the firewall fuel shut-off valves, is controlled from the systems operators lower panel (Ref.Fig. 13) which incorporates the fuel selector switches, booster pump switches, manifold shut-off valve switches, fuel dump switches, contents indicators and test switch, fuel selector valve not synchronized lights and fuel low pressure warning lights. The firewall shut-off valves are controlled by the engine condition levers. The fuelling/defuelling system, besides being controlled from the systems operators fuel panel, is also operated from the ground control panel located on the underside of the starboard outer nacelle.

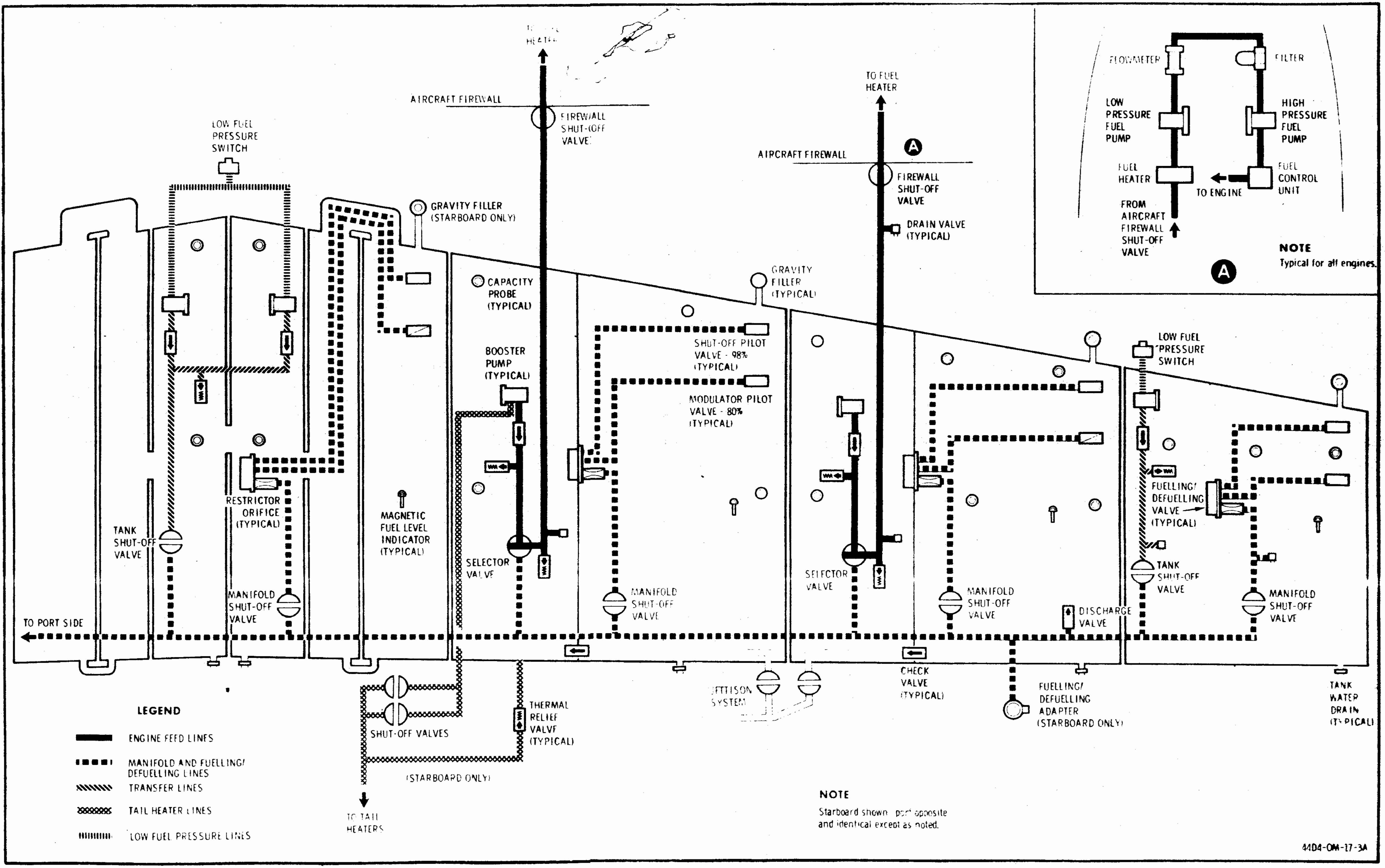
C. Fuel Selector Switches

Four six-position main tank selector valves are installed on the rear spar. The valve for each main tank is connected to the manifold, the booster pump and the engine by three separate lines and is operated by a rotary selector switch located on the systems operators fuel control panel. Refer to Section 2 for details of fuel management.

Amber warning lights, marked SELECTOR VALVE NOT SYNCHRONIZED, are located below the selector switches and illuminate while the selector valves are motoring to the position indicated by the selector switches. The positions of the selector switches are: TANK-MANIFOLD; TANK-ENGINE; TANK-ENGINE-MANIFOLD; MANIFOLD-ENGINE; TANK-MANIFOLD; OFF.

D. Booster Pump Switches

Each tank is equipped with a fuel booster pump, with the exception of the centre auxiliary tank which has two booster pumps. The pumps, completely immersed in fuel, are electrically driven and operate on constant-



Fuel System - Schematic
Figure 11

frequency a.c. power supply. The pumps feeding the engines are run continually to assure adequate fuel pressure at all times.

The booster pumps are controlled by individual on-off switches located on the systems operators fuel control panel. The auxiliary tank booster pump switches are lever-locked in the OFF position to prevent inadvertent selection of the switches to the ON position.

E. Manifold Shut-off Valve Switches

A 28-volt d.c. actuator-operated manifold shut-off valve, installed between the manifold and each tank fuelling/defuelling shut-off valve, prevents fuel flow from the manifold to the tank when not transferring fuel, fuelling or defuelling.

Each manifold shut-off valve is controlled by a switch, located on the systems operators fuel control panel, having three positions marked OPEN, CLOSE and GROUND. When the switch is placed to GROUND, control of the manifold shut-off valve is transferred to the pressure fuelling panel in the starboard outer nacelle.

F. Contents Indicators

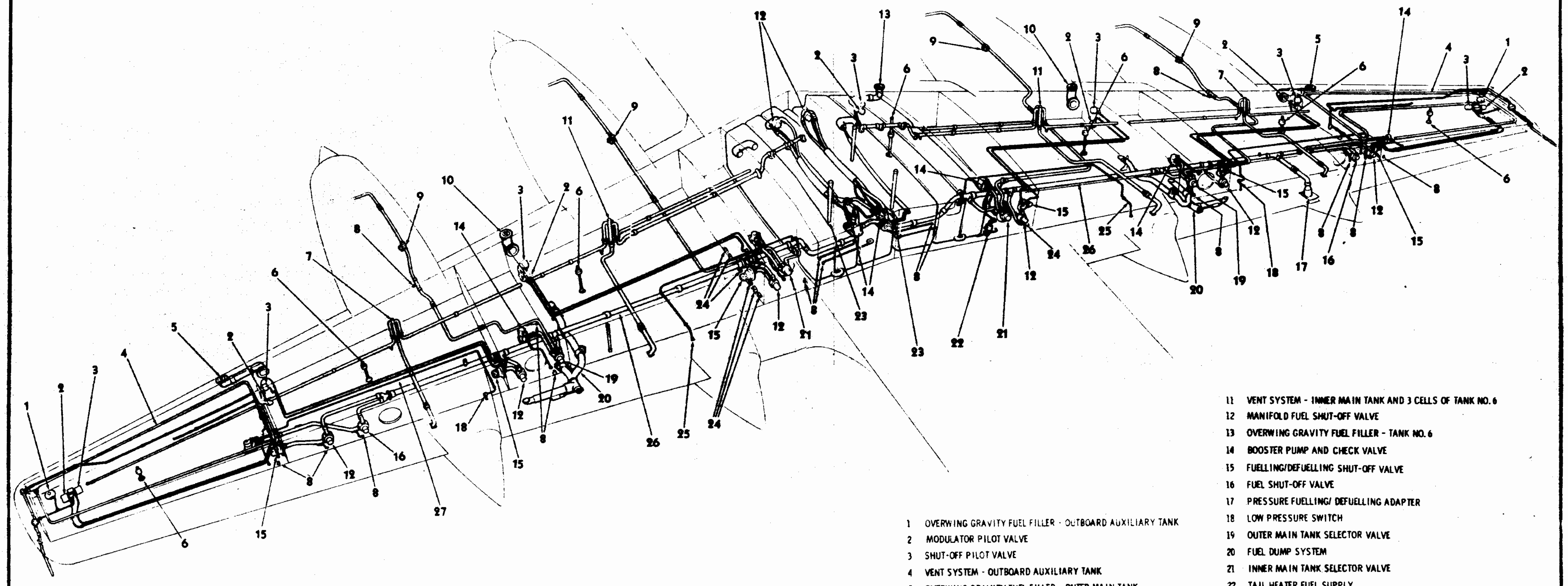
The fuel quantity indicating system consists of seven fuel contents indicators and a single contents totalizer on the systems operators fuel control panel. The individual tank indicators are energized by capacitor-type tank probes and are calibrated in pounds of fuel. The totalizer, also calibrated in pounds of fuel, shows the aggregate of all fuel carried in the tanks.

A contents indicator test switch is installed on the right-hand side of the systems operators panel for checking the serviceability of the indicators.

G. Magnetic Fluid Level Indicators

A magnetic-type dipstick is installed in each of the seven tanks to facilitate fuel contents reading on the ground. The unit is installed in the tank in an upright position and is secured on the bottom of the tank.

The indicator consists of an outer tube sealed at the top and open to atmosphere at the bottom. Around this tube is a doughnut-shaped float, the centre of which contains a magnet. The float is free to slide up and down the tube and follow the fuel level in the tank. A graduated register tube normally latched in position is also fitted with a magnet. When the locking plug is turned 90° either to the right or to the left, the register tube slides down until its magnet comes into the field of the float magnet and the quantity of fuel in the tank can then be read on the graduated scale which



1 OVERWING GRAVITY FUEL FILLER - OUTBOARD AUXILIARY TANK
2 MODULATOR PILOT VALVE
3 SHUT-OFF PILOT VALVE
4 VENT SYSTEM - OUTBOARD AUXILIARY TANK
5 OVERWING GRAVITY FUEL FILLER - OUTER MAIN TANK
6 MAGNETIC FUEL LEVEL INDICATOR
7 VENT SYSTEM - OUTER MAIN TANK
8 DRAIN VALVES
9 FIREWALL FUEL SHUT-OFF VALVE
10 OVERWING GRAVITY FUEL FILLER - INNER MAIN TANK
11 VENT SYSTEM - INNER MAIN TANK AND 3 CELLS OF TANK NO. 6
12 MANIFOLD FUEL SHUT-OFF VALVE
13 OVERWING GRAVITY FUEL FILLER - TANK NO. 6
14 BOOSTER PUMP AND CHECK VALVE
15 FUELLING/DEFUELLING SHUT-OFF VALVE
16 FUEL SHUT-OFF VALVE
17 PRESSURE FUELLING/ DEFUELLING ADAPTER
18 LOW PRESSURE SWITCH
19 OUTER MAIN TANK SELECTOR VALVE
20 FUEL DUMP SYSTEM
21 INNER MAIN TANK SELECTOR VALVE
22 TAIL HEATER FUEL SUPPLY
23 CAPACITOR-TYPE PROBE
24 RIB CHECK VALVE
25 CAVITY VENT
26 PRESSURE MANIFOLD SYSTEM
27 LOW FUEL PRESSURE LINE

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Fuel and Vent System
Figure 13

denotes fuel quantity in US gallons. To ensure proper reading, the figures immediately above the graduation marks are used.

The register tube is stowed by exerting a sharp up-movement on the locking plug to break the magnetic field and then pushed and locked back in position by turning the locking plug 90° to the right or to the left.

H. Low Fuel Pressure Warning Lights

Red low fuel pressure warning lights on the systems operators fuel control panel and on the annunciator panels illuminate when the fuel pressure upstream of the high pressure pump falls below 9 psi. Three amber low pressure warning lights on the systems operators lower panel illuminate when the pressure in the fuel supply line from the auxiliary tanks drops below 2(±0.5) psi.

I. Auxiliary Tank Shut-off Valves

A shut-off valve, installed on each auxiliary tank booster pump output line, isolates the tank when its associated booster pump is not in operation. On-off switches, located on the systems operators fuel panel, control simultaneous operation of both the booster pump and shut-off valve in each auxiliary fuel tank.

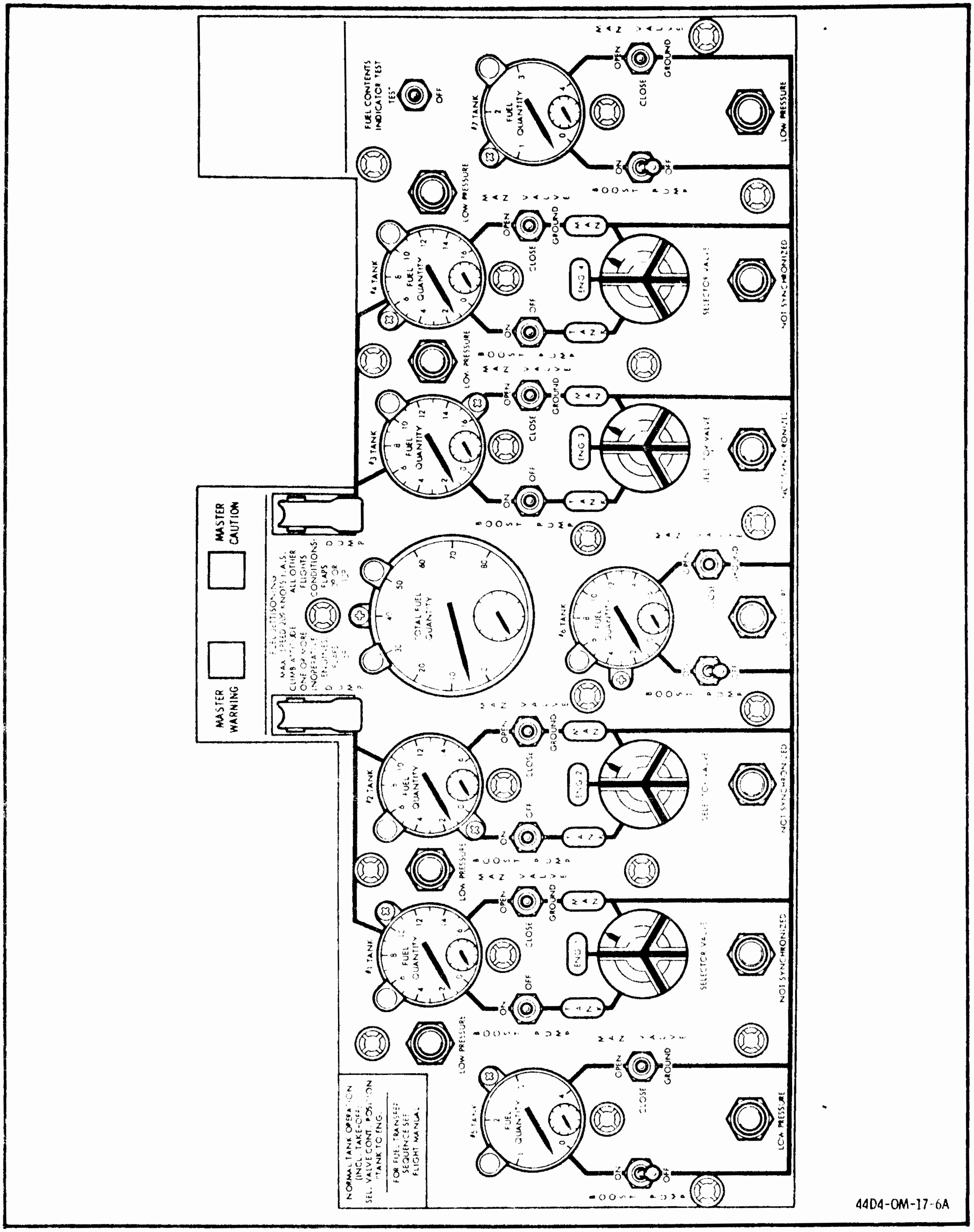
J. Firewall Fuel Shut-off Valves

A fuel shut-off valve installed on the aft face of the aircraft firewall in each nacelle cuts off the fuel supply to the engine in case of engine fire. Each valve, normally open, is controlled by its respective engine condition lever when the latter is placed in the PULL TO ARM FIREX position.

K. Tank and Cavity Venting

Fuel tank venting is accomplished through lines which vent the main and centre auxiliary tanks to atmosphere at points located outboard of the engine nacelles. The outboard auxiliary tanks are vented at points located at the wing tips.

Venting of the centre auxiliary tank cavity is accomplished through a line having a discharge point adjacent to the inner main tank vent in the lower surface of each wing. This venting arrangement provides low pressure around the rubber cells, causing a differential pressure between the interior and exterior of the cells, thus preventing collapse of the tank (Ref. Fig. 14).



Systems Operators Fuel Control Panel
Figure 14

L. Fuel Transfer System

Fuel may be transferred through the manifold system from any tank or combination of tanks to any other tank. Fuel transfer is controlled by the fuel selector switches and the manifold shut-off switches. For fuel transfer procedures, refer to Section 2.

M. Fuel Cross-feed System

Fuel may be distributed from any main tank or combination of main tanks to any engine or combination of engines through the manifold system. The cross-feed operation is controlled by the fuel selector switches. For fuel cross-feed procedures, refer to Section 2.

N. Fuelling and Defuelling System

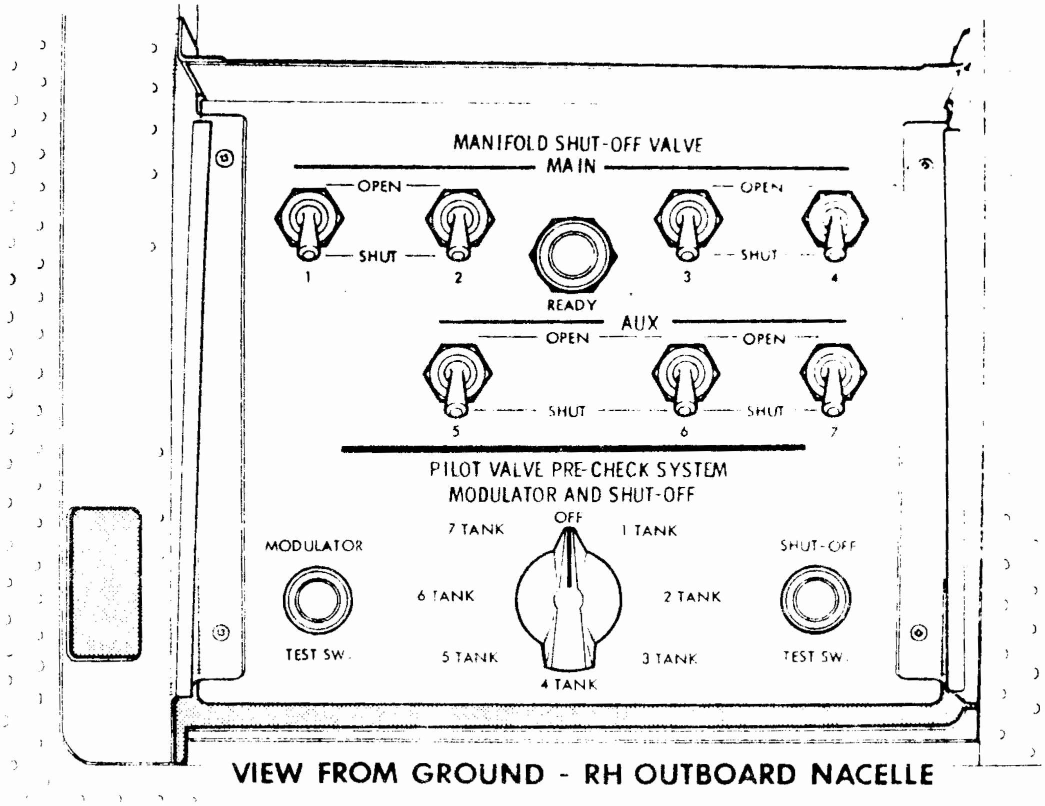
Pressure fuelling and defuelling of the aircraft is achieved through a single-point adapter located on the underside of the starboard outer nacelle and connected to the fuel system manifold. The manifold and valves permit a fuelling rate of 600 US (500 Imperial) gallons per minute at 50 psi. The fuel flow is controlled by the manifold shut-off valves, fuelling/defuelling shut-off valves, 80% fuel level modulating valves and 98% fuel level pilot valves. Each tank is equipped with a filler adapter on the upper surface of the wing for gravity fuelling in the event that pressure fuelling equipment is not available, or should a fuelling system component become defective during pressure fuelling procedures.

O. Fuelling/Defuelling Shut-Off Valve

The fuelling/defuelling shut-off valve is a pressure-operated pilot type unit installed in each tank. During pressure fuelling procedures, the volumetric flow of fuel through the fuelling/defuelling valve is controlled by the action of the 80% modulating and 98% shut-off pilot valves when the fuel in the tank reaches predetermined levels.

P. Modulating and Shut-off Pilot Valves

The modulating and shut-off pilot valves are pressure-operated type valves installed at the 80% and 98% levels in each one of the tanks. When the tank is approximately 80% full, the modulating valve partially closes the fuelling/defuelling shut-off valve, thus reducing the flow rate from 150 to 50 US (125 to 42 Imperial) gallons per minute except in tanks No. 5 and No. 7 where the modulated rate is 7.2 to 10.8 US (6 to 9 Imperial) gallons per minute. When the tank is 98% full, the shut-off pilot valve completely closes the fuelling/defuelling shut-off valve.



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Pressure Fuelling System - Ground Control Panel
Figure 15

TEMPORARY REVISION NO. 17-8

Insert in Section 17, facing Page 53 dated 22 Sep 61

FUEL DUMP SYSTEM

REASON FOR ISSUE

To clarify text.

ACTION

Delete the second Paragraph of 8.S. in its entirety and add new Paragraph as follows:

> Approximately 536 US (447 Imperial) gallons of usable fuel will remain in each inboard main tank and approximately 96 US (80.5 Imperial) gallons of usable fuel will remain in each outboard main tank after dumping is completed. Ground safety switches on the landing gear prevent accidental dumping while the aircraft is on the ground.
>
> NOTE: The variation in usable fuel quantities between "in flight" and "ground" quantities is due to siphoning effect in flight.

TEMPORARY REVISION No. 17-9 (ISSUE 1)

(This TR cancels and supersedes TR 17-9 dated 25 Apr 66)

Insert in Section 17, facing Page 53 dated 22 Sep 61

FOR FLYING TIGER AIRCRAFT ONLY

FUEL DUMP SYSTEM

REASON FOR ISSUE

To revise fuel quantities after jettisoning, when Service Bulletin CL44D4-451 is incorporated.

ACTION

Delete the second Paragraph of 8.S. in its entirety and add new Paragraph as follows:

Approximately 270 US (225 Imperial) gallons of usable fuel will remain in each inboard main tank and approximately 96 US (80 Imperial) gallons of usable fuel will remain in each outboard main tank after dumping is completed. Ground safety switches on the landing gear prevent accidental dumping while the aircraft is on the ground.

NOTE: The variation in usable fuel quantities between "in flight" and "ground" quantities is due to siphoning effect in flight.

Q. Fuelling Ground Control Panel (Ref. Fig. 15)

The pressure fuelling ground control panel is located on the underside of the starboard outer nacelle. The fuelling controls consist of seven manifold shut-off valve switches, an eight-position tank selector switch, a modulating valve test switch, a shut-off pilot valve test switch and a green indicator light.

The seven manifold shut-off valve switches on the ground panel control the operation of the manifold shut-off valves only when the manifold shut-off valve switches on the systems operators fuel control panel have been placed to the GROUND position.

The two test switches enable the modulating and shut-off pilot valves to be checked for serviceability at the start of the pressure fuelling operation. The green indicator light shows that the fuel selector valves are in the correct position for pressure fuelling (in any position other than manifold-to-engine) and illuminates only when all the fuel selector switches on the systems operators fuel control panel are placed to positions other than manifold-to-engine.

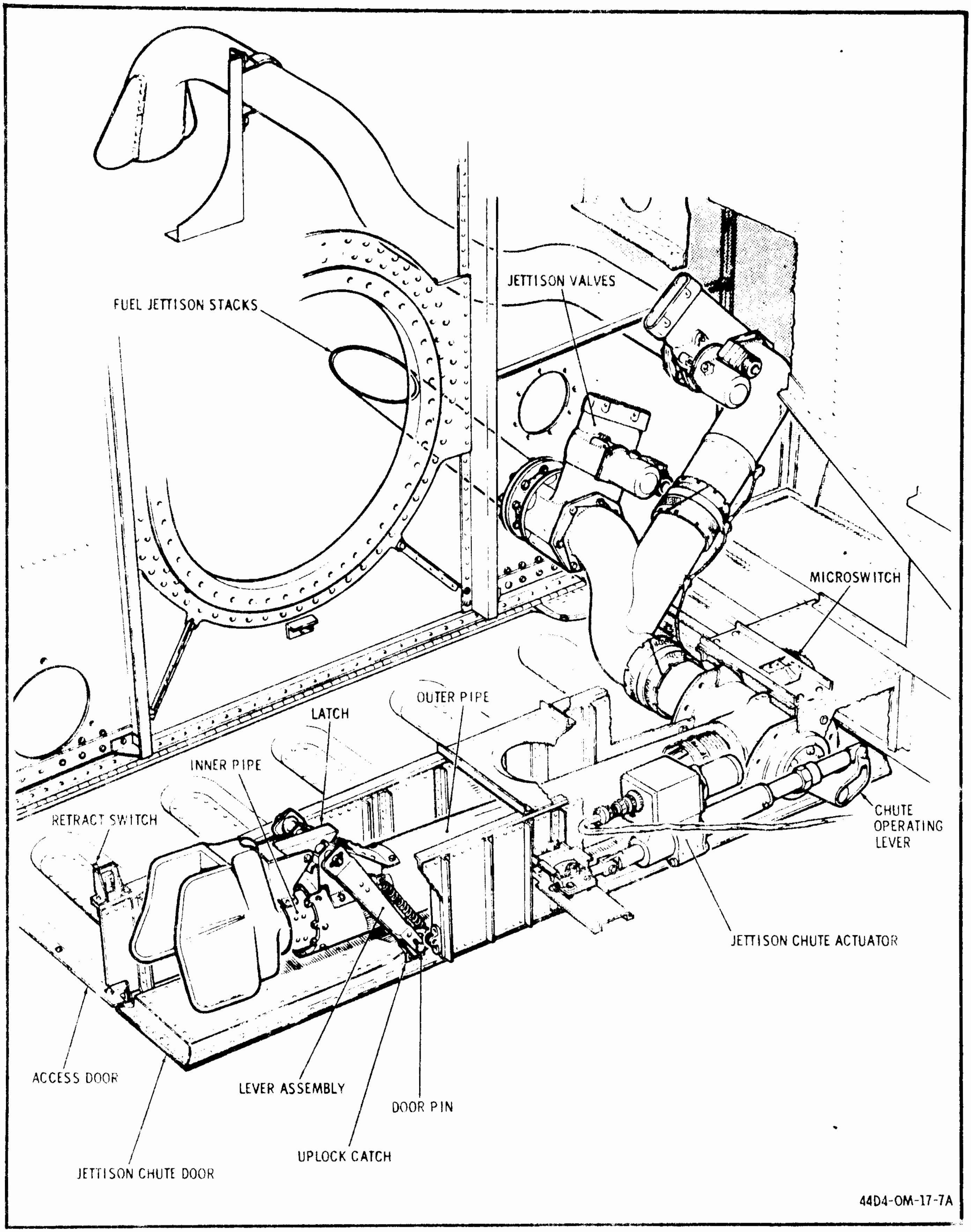
R. Defuelling

Fuel may be off-loaded via the manifold system through the pressure fuelling adapter at a maximum rate of 210 US (175 Imperial) gallons per minute at -7 psi. Each fuelling/defuelling shut-off valve is closed automatically when the fuel level in its associated tank drops down to approximately 10%, thus maintaining suction in the fuelling/defuelling system.

S. Fuel Dump System (Ref. Fig. 16)

Fuel is dumped from the main fuel tanks via an extendible chute located on the underside of each wing between the inner and outer nacelles. Fuel can be dumped from the auxiliary tanks only by transferring to the main tanks. The fuel dump system is electrically operated and enables fuel to be dumped at a flow rate of approximately 315 US (263 Imperial) gallons per minute. Fuel can be dumped from either side separately or both sides simultaneously and the operation can be started and stopped at any desired time.

Approximately 447 US (372 Imperial) gallons of usable fuel will remain in each inboard main tank and approximately 80 US (67 Imperial) gallons of usable fuel will remain in each outboard main tank after dumping is completed. Ground safety switches on the landing gear prevent accidental dumping while the aircraft is on the ground.



Fuel Dump System
Figure 16

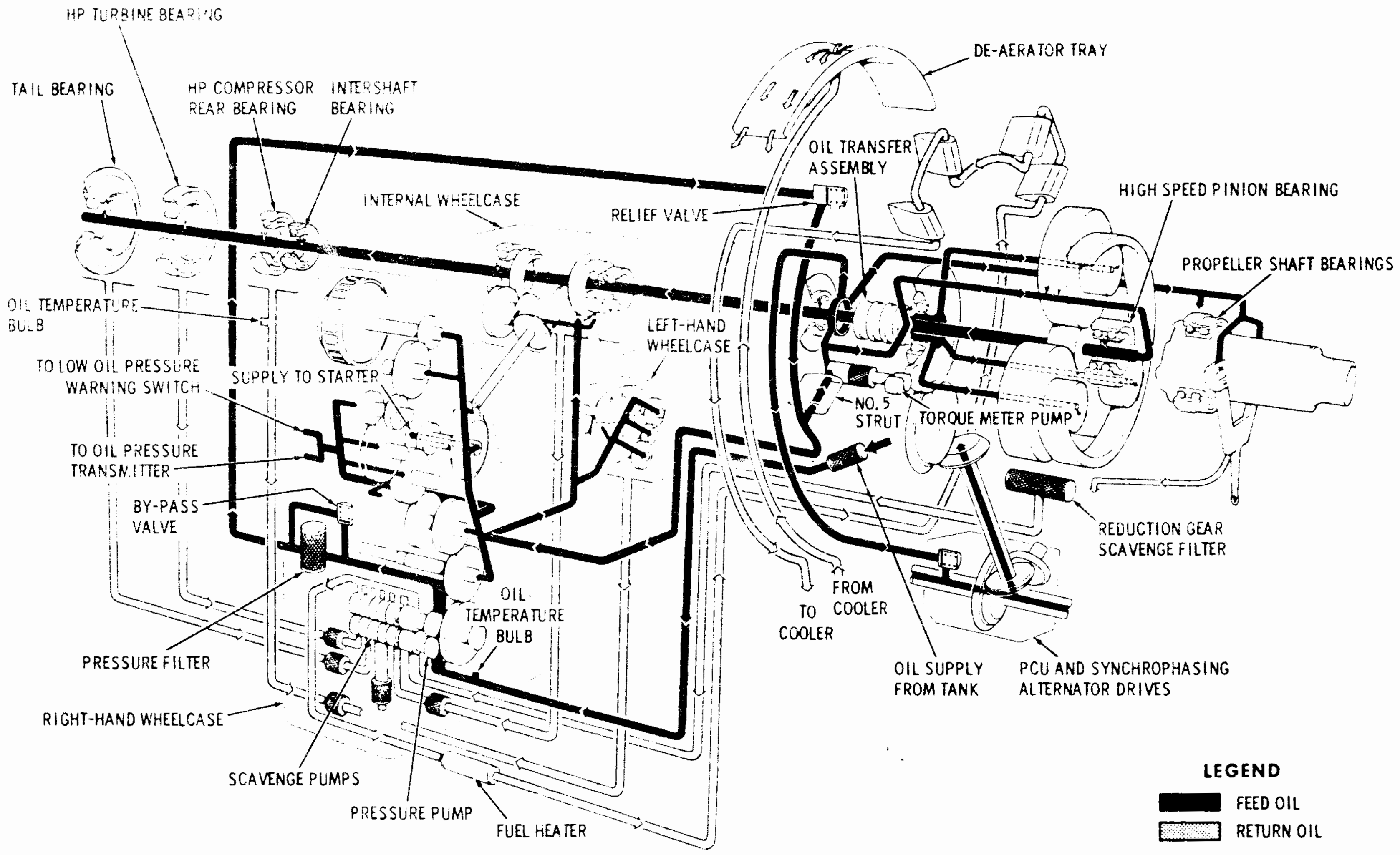
T. Fuel Dump Controls

The installations are identical for the port and starboard wing and are controlled by two guarded switches on the systems operators fuel control panel. When the switches are placed in the OPEN position, the jettison chutes are lowered and the inner portion of the pipes rotated so that the outlet faces aft. When the dump chutes reach the fully extended position, limit switches complete the circuit to open the jettison valves. Placing the dump switches in the CLOSE position shuts off the fuel flow. The dump chutes cannot be retracted in flight, but may be retracted on the ground by use of the chute retract switch adjacent to the chute.

U. Power Sources

The circuit-breakers and power sources for the aircraft fuel system are as follows:

		Quantity
(1)	Constant-frequency A.C. Bus A	
	Fuel Booster Pumps Supply - Main No. 1 and Main No. 2	6
	Fuel Booster Pumps Supply - Auxiliary No. 5 and No. 6	6
	Fuel Quantity System - Main Tanks Nos 1,2,3 and 4	4
	Fuel Quantity System - Aux Tanks Nos 5,6 and 7	3
	Fuel Quantity System - Totalizer	1
(2)	Constant-frequency A.C. Bus B	
	Fuel Booster Pumps - Main Nos 3 and 4	6
	Fuel Booster Pumps - Auxiliary Nos 6 and 7	6
(3)	D.C. Main Bus	
	Auxiliary Fuel Tanks - Manifold Shut-off Valves Nos 5 to 7	3
	Primary Fuel System Master - Normal	1
(4)	D.C. Essential Bus Panel B	
	Fuel Selector Valves Nos 1,2,3 and 4	4
	Fuel Jettison - Master Standby	1
	Fuel Jettison System - Dump Valve Nos 1,2,3 and 4	4
	Fuel Jettison System - Chute Act and Dump Valve Control LH and RH	2



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Oil Distribution Diagram
Figure 17

	Quantity
Aux Fuel Tanks Control - S/O Valves and Booster Pumps Nos 5,6 and 7	3
Aux Fuel Tanks Control - Low Pressure Warning	1
Main Fuel Tanks - Manifold S/O Nos 1,2,3 and 4	4
Main Fuel Tanks Booster Pumps Nos 1,2,3 and 4	4
Fuel Low Pressure Warning Nos 1,2,3 and 4	4

9. Oil System (Ref. Fig. 17)

With the exception of the oil cooler and associated plumbing, the oil system is completely self-contained within the engine. The oil is contained in a tank mounted around the air intake casing, and circulated by one feed pump and six scavenge pumps located in the high pressure wheelcase.

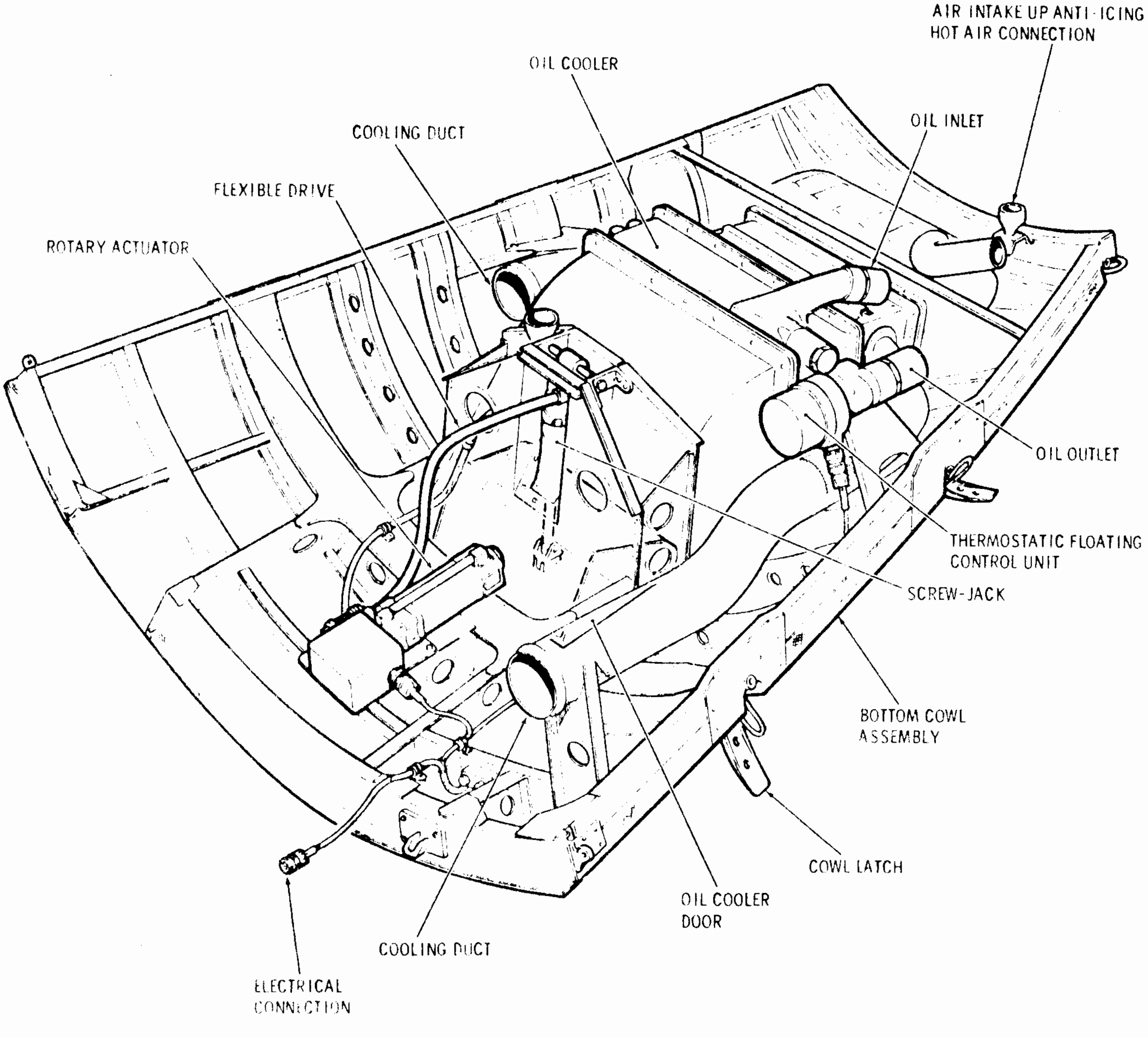
The pressure pump draws oil from the tank through a filter housed in the air intake casing and delivers it rearwards to a pressure filter in the port side of the high pressure wheelcase. A spring-loaded by-pass valve across the filter prevents engine oil starvation should a blockage occur in the filter. From the filter, the oil is transferred to the intermediate casing and then by an external pipe to a relief valve housed in a boss in the air intake casing. The relief valve discharges directly into the oil tank while the main flow is conveyed by a pipe to No. 5 strut of the air intake, where the flow divides to feed the main rotating assemblies and the wheelcases.

The scavenge pumps discharge into a common outlet, the combined return being directed through the fuel heater and the top four air intake struts for anti-icing purposes before passing to the oil cooler. From the cooler, the oil is returned to the tank and directed over an internal deaerator tray to permit the release of any included air.

A. Oil Tank

The fabricated stainless steel oil tank is of L-shaped section and is mounted around the rear of the air intake casing, the external surface of the casing thus forming the internal wall of the tank. The front flange of the tank is bolted to a flange on the intake casing, and the rear flange is trapped between a face at the rear of the intake and the front flange of the LP compressor casing. Oil leakage into the compressor is prevented by a rubber seal at this joint.

A platform is provided on the starboard side of the tank for an oil filler cap and a dipstick. The dipstick is graduated in US pints. Any excess oil, due to overfilling, is allowed to flow into an overflow pocket and then overboard through a drain.



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Oil Cooler and Exhaust Flap Mechanism
Figure 18

A deaeration tray is mounted in the top half of the tank and oil from the cooler is fed upward onto it through a channel integral with the tray. As the oil flows over each side of the tray from the centre, the air escapes from the top and is collected by a pipe forming part of the common oil tank and reduction gear breather connection.

B. Breather

With the exception of the LP turbine rear bearing, the oil tank and all lubricated compartments in the engine are interconnected and vented to atmosphere through a centrifugal breather in the HP wheelcase. The breather, which is basically a vaned rotor driven from the spur gear train on the HP wheelcase, separates the oil and the air. The oil which is thrown outwards collects on the flanged vanes of the rotor and is returned to the wheelcase, while the air is exhausted to atmosphere through a protective grill.

C. Feathering Pump

The feathering pump and motor assembly are mounted on the low pressure compressor casing. The pump motor is energized by 115/200-volt a.c. power from the main distribution panel through a feathering pump power relay which in turn is energized by 28-volt d.c. power from the main d.c. bus when the condition lever is at feather and the feathering microswitch is closed. The feathering pump draws oil from the feathering reserve at the bottom of the tank and passes high pressure oil through the propeller control unit to the propeller. Return from the propeller passes through the PCU directly to the tank.

D. Oil Cooler (Ref. Fig. 18)

The oil cooler is mounted within the bottom cowling of the engine and consists of a rectangular structure containing a matrix, oil inlet and outlet ports and a by-pass valve. The exhaust flap and its thermostatic floating control unit are also installed within the cowling. Scavenge oil from the engine enters the cooler, flows through the cooler in a directed path, and leaves the cooler to return to the tank. If pressure build-up within the cooler exceeds 25 psi, a by-pass pressure relief valve opens and allows the oil to pass directly to the outlet and by-pass the matrix.

E. Oil Cooler Exhaust Flap Controls

The oil cooler exhaust flap actuation system controls engine oil temperature by regulating the flow of cooling air through the oil cooler. The position of the flap is controlled either automatically by the floating control thermostat, or manually by a selector switch in the cockpit which can override the automatic control at any time. The temperature range of the thermostat is

78.6° to 85.8°C. The oil cooler control switch is located on the pilots lower centre instrument panel and is marked AUTO, OFF, OPEN and CLOSE.

F. Oil Temperature Indicators

Four engine oil temperature indicators are located on the pilots lower centre instrument panel directly below the oil cooler exhaust flap controls. Each gauge indicates the oil temperature in degrees Centigrade. The temperature sensor probe is located upstream of the pressure pump. Oil temperature at the HP turbine rear bearing is measured by a thermometer bulb located in the scavenge line immediately downstream of the HP turbine bearing. Dual temperature indicators are mounted on the systems operators lower instrument panel. Power for the system is supplied from the d.c. essential bus B through circuit-breakers, one for each indicator.

G. Oil Pressure Indicators

Four oil pressure gauges are located on the pilots centre instrument panel. Each gauge indicates the oil pressure in pounds per square inch. The oil pressure is tapped from the rear face of the high pressure wheelcase. Four windows on each annunciator panel, labelled OIL PRESSURE, illuminate when the oil pressure falls below 35 psi and go out when the oil pressure rises above 38 psi. The master caution lights flash whenever the window illuminates.

H. Power Sources

The circuit-breakers and power sources for the oil system are as follows:

	Quantity
(1) Constant-frequency Panel A	
Engine Oil Pressure Indicators No. 1,2,3 and 4	4
(2) D.C. Main	
Oil Cooler Flaps Control No. 1,2,3 and 4	4
(3) D.C. Essential Bus - Panel B	
Oil Inlet Temperature Indicator No. 1,2,3 and 4	4
Low Oil Pressure Warning No. 1,2,3 and 4	4
HP Turbine Oil Temp Ind No. 1 and 2	1
HP Turbine Oil Temp Ind No. 3 and 4	1

RADAR, RADIO, AND NAVIGATION

Weather Radar

The PDR-1 (C band) radar provides facilities for weather mapping, ground mapping and advance warning of high ground. Weather information and terrain features are displayed on the radar screen in range and azimuth, relative to the aircraft heading, up to a distance of approximately 150 nautical miles, within the scanning angle. A rainfall-rate contour circuit provides a visual pattern of rainfall rate gradient (rain density gradient) within thunderstorm clouds thus indicating the areas of turbulence to be avoided. When energized, the contour circuit causes the normal radar presentation to display areas of high rainfall rate as black holes. The position, intensity and extent of a storm cell or cells within clouds is therefore immediately apparent.

A. Operation

The radar consists of an antenna, a transceiver, a control, a synchronizer, and two indicators. The operating frequency is 5400 (±30) megacycles. The radar antenna radiates pulses of energy in a narrow pencil beam and the returned echo is received by the antenna, amplified by the receiver, and presented in range and azimuth on the CRT indicator. The sweep trace starts near the bottom of the CRT giving an offset presentation. The trace sweeps to the edge of the tube and the trace rotates in step with the antenna scan. Range is indicated by means of range marks (concentric circles).

Trigger frequency is controlled by the 115-volt 380 to 420 cycle a.c. aircraft power supply which triggers the blocking oscillator in the synchronizer. The trigger frequency is therefore held to 400 (±20) cycles. Trigger pulses are supplied to the transmitter and the two indicators. The two identical indicators each receive simultaneous azimuth bearing data from the antenna and the indicators are synchronized with the antenna rotation.

The antenna tilt angle may be adjusted between +15° and -15° by the ANT TILT on the CON-IL4 control. The antenna is rotated 360° at 15 (±3) rpm, but the indicated scan is limited to 120° on either side of the aircraft heading. The scanned area on the indicator holds its relative position on the screen against pitching and rolling of the aircraft by the vertical gyro and the radar stabilizing system. The 0° antenna tilt is referenced to the verticle gyro which produces error voltages that are fed to the radar stabilizing system to maintain a constant radiation angle.

B. Components and Locations

The components and their locations are as follows:

B. Components and Locations (Continued)

Component	Location
Antenna	Nose Radome
Transmitter Receiver	Navigators Rack
Control	Pilots Overhead Panel
Synchronizer-Amplifier Power Supply	Navigators Rack
Indicator No. 1	Pilots Station
Indicator No. 2	Co-Pilots Station (LL aircraft)

C. Control

The Con-IL-4 control unit provides facilities for operation of the radar set from the pilots overhead panel (Ref. Fig. 1). The control unit has the following features:

(1) A rotary switch having four positions, OFF, STANDBY, NORMAL, and CONTOUR.

(2) An antenna tilt control marked 0° to 15° up and down.

(3) A gain control.

(4) A dimmer control for adjusting the panel lights.

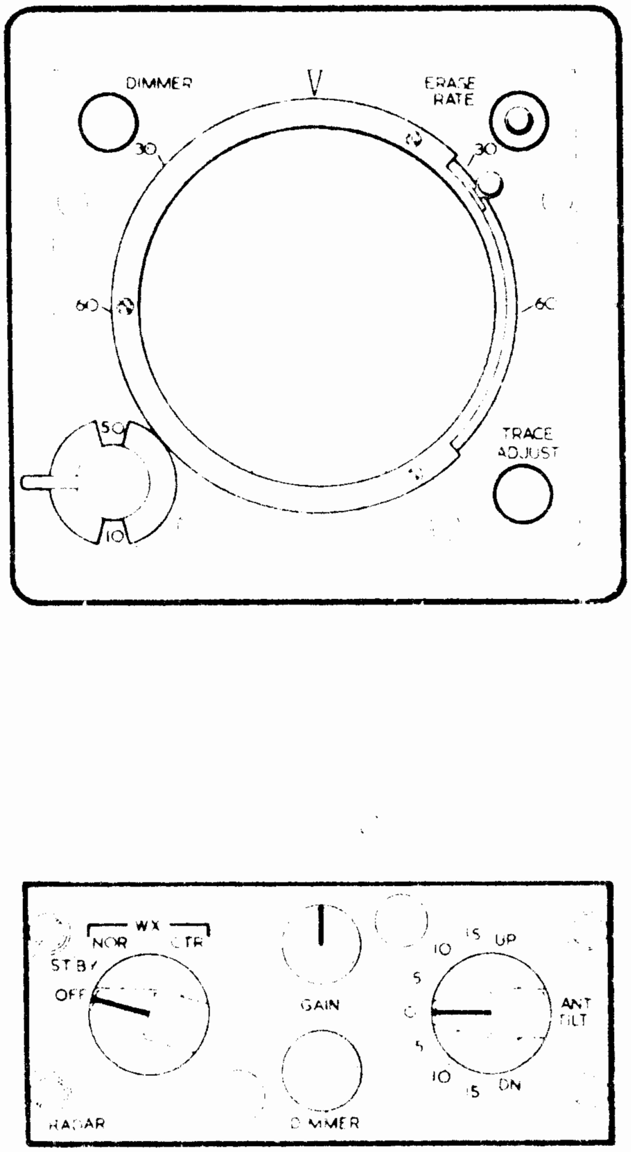
D. Indicators

Two PIP-10 indicators are included in the system, one in each of the pilots and co-pilots positions. Each indicator provides a visual display consisting of video information and range mark signals (Ref. Fig. 1). Four controls are mounted on the PPI-1E front panel: RANGE AND MARKS, TRACE ADJUST, ERASE RATE and DIMMER.

The indicator has an off-center plan-position display with azimuth coverage up to 120° on each side of the aircraft heading. Ranges of 20, 50, and 150 nautical miles may be selected with a range mark interval of 5, 10, and 25 nautical miles respectively.

E. Power

The radar uses 115-volt a.c. and 28-volt d.c. from the aircraft power



4404-OM-18 11 B

Weather Radar Control and Indicator
Figure 1

E. Power (Continued)

supply. The 115-volt a.c. is supplied from a 15 ampere circuit-breaker and 28-volt d.c. from a 5-ampere circuit-breaker. Both breakers are located in the radio junction box. Pitch and roll voltages are supplied by the aircraft vertical gyro for stabilizing the antenna.

ATC Transponder

A Collins 621A-3 ATC transponder is used in cooperation with ground control stations for air traffic control (ATC) and operates on a receiver frequency of 1030 mc and a transmitter frequency of 1090 mc with a power output of 500 watts. The transponder is the reply portion of the Air Traffic Control Radar Beacon System receiving interrogations from a ground station and transmitting coded reply signals. The transponder responds to all valid ATC ground radar interrogations with a coded reply signal. This coded reply signal is used to identify and locate transponder equipped aircraft for the air traffic control.

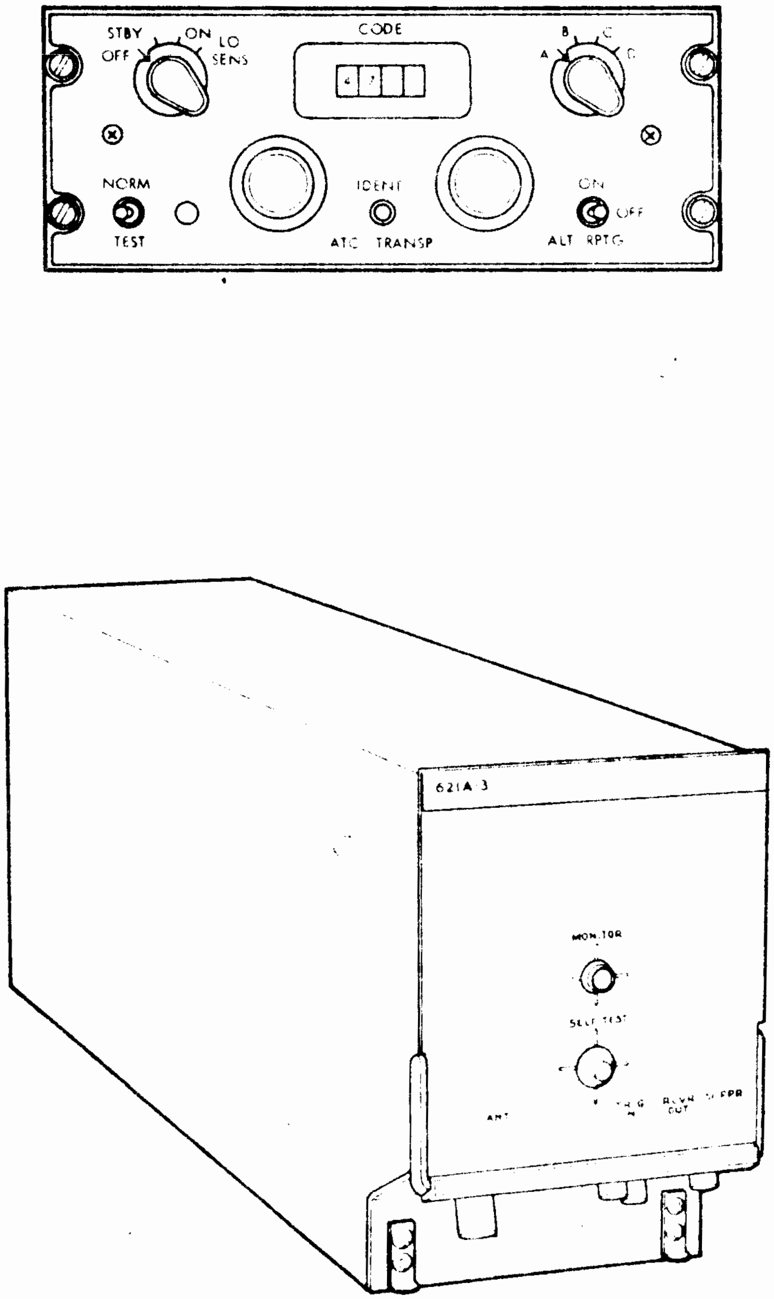
An audio monitoring facility is provided on the A81-4 intercom control panels (Ref. Fig.8) and is readily made available if required. The visual monitoring facility (green indicator light on the control) indicates proper transmitter operation.

A. Components and Locations

COMPONENT	DESIGNATION	LOCATION
Control (Collins)	099-2622-00	Pilots Overhead Panel
Transponder (Collins)	621A-3 (522-2703-00)	Forward Hold
Shockmount (Collins)	350E-3D (522-0569-004)	Forward Hold
Antenna (Collins)	237Z-1	Lower Fuselage Skin (Forward hold)

B. Control (Figure 2)

The control unit contains the controls necessary for operation of the transponder. Controls include a function switch, code selector, mode selector, identification switch, normal-test and an altitude reporting switch.



4404-MM-34-37

ATC Transponder and Controls
Figure 2

B. Control (Figure 2) (Continued)

(1) Function Switch

The function switch has four positions: OFF, STANDBY, ON and LOW SENSITIVITY. The transponder may be turned to STANDBY and, after approximately 80 seconds, may be turned to ON or LOW SENSITIVITY with immediate operation. Alternatively, the transponder may be turned to ON or LOW SENSITIVITY immediately and, approximately 80 seconds later, voltage is applied to the transponder. Transponder gain is reduced when LOW SENSITIVITY is selected.

(2) Code Selector Switch

The code selector switch selects the code which is to be transmitted in response to ground interrogations.

(3) Mode Selector Switch

The mode selector switch determines the time spacing between interrogation pulses required for operating the transponder. The four modes of operation available are A, B, C and D. Modes, A, B, and C are presently the only modes used for air traffic control. Mode C has been designated for automatic altitude reporting, and mode D is as yet unassigned. Circuits for mode C and D are incorporated in the 621A-3 system. Pulse pair spacings for the four modes of operation are: Mode A, 8 microseconds; Mode B, 17 microseconds; Mode C, 21 microseconds; Mode D, 25 microseconds.

(4) IDENT Switch

Special identification pulses are transmitted for a present length of time (25 seconds following release of the IDENT switch) when the IDENT switch, upon request from the ground controller, is activiated momentarily.

(5) Normal/Test Switch

The normal/test switch and associated monitor light permits testings the performance of the transponder while in flight or on ground. Placing the switch to TEST provides an interrogation signal. The monitor light is illuminated whenever the transponder is transmitting, verifying that the transponder is functioning properly.

(6) ALT RPTG Switch

The altitude reporting switch, together with the mode selector switch, when used in conjunction with an altitude digitizer or computer,

B. Control (Continued)

(6) ALT RPTG Switch (Continued)

automatically provides the ground controller with aircraft altitude information.

C. Transponder (Ref. Fig. 2)

The 621A-3 ATC transponder is a completely transistorized receiver-transmitter containing circuitry for both two pulse (ICAO) and three pulse (FAA) sidelobe suppression. The suppression circuits prevent triggering of the system by the sidelobes of the secondary surveillance radar (SSR) which would supply false replies to the ATC ground station and obscure the aircraft location.

To prevent interaction between the ATC and DME, both equipments using L-band, an external suppression cable is connected between the two transponders to disable the DME decoder when the ATC is transmitting or, comversely, the ATC receiver portion when the DME is transmitting.

The transponder contains an expanded reply code system of 4096 codes available on all four modes. Transponders are adjusted to the mode and code designated by the cognizant air traffic control agency.

D. Power

The aircraft power requirement for the transponder is 115-volt a.c.

Distance Measuring Equipment

The 860E-2 distance measuring equipment (DME) electronically measures the line-of-sight (slant) distance from an aircraft to a fixed TACAN or VORTAC station. The transmitter portion of the 860E-2 DME transmits a pair of shaped and coded interrogation pulses at a frequency between 1025 and 1150 mc inclusively.

These interrogation pulses are received by the selected TACAN or VORTAC ground station. The ground station, after a fixed time delay, transmits a pair of reply pulses either 63 mc above or below the interrogation frequency. These pulses are received by the receiver portion of the 860E-2 DME and are applied to the computing circuits. The computing circuits measure the round-trip travel time, or the time interval between the interrogation and reply pulses. This time interval, which is proportional to the slant range between the aircraft and the ground station, is converted to distance information and is displayed the DME distance indicators.

D. Power (continued)

An audio monitoring facility is provided on the A81-4 intercom controls (Ref. Fig 8) at the pilots and co-pilots station, and is readily made available if required.

A. Components and Locations

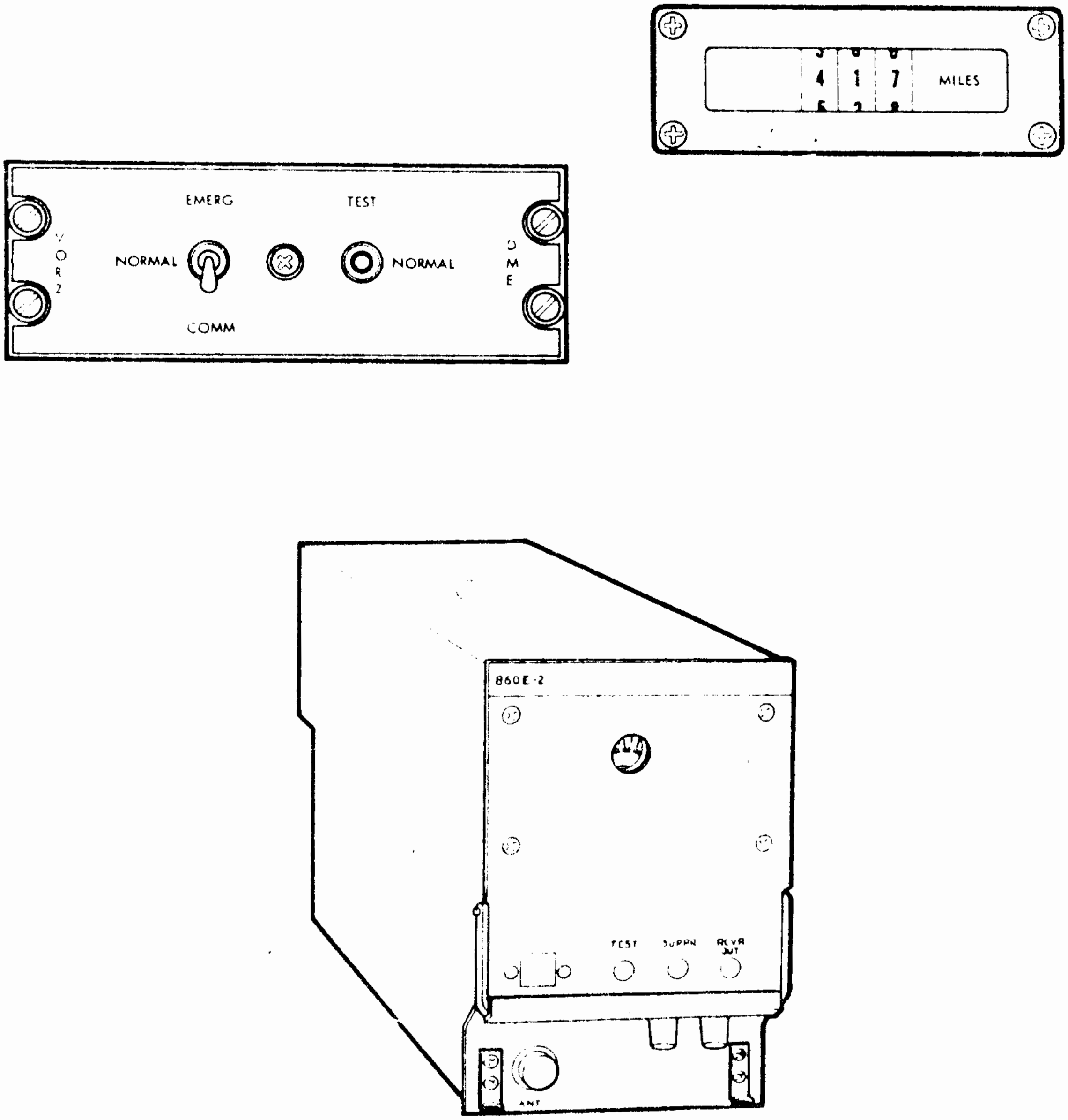
The components and their locations are as follows:

COMPONENT	DESIGNATION	LOCATION
Distance Measuring Equipment	860E-2	Forward Baggage Hold
Shockmount	349D-3B	Forward Baggage Hold
Control		Co-pilots Overhead Panels
Indicator (2)	339D-1	
Antenna	237Z-1	Bottom Fuselage (Forward Hold)
Circuit-breaker (2)		Radio Junction Box

B. Operation

The distance measuring equipment (DME) consists of a transponder, two indicators, control unit and an antenna (Ref. Fig 3). DME may be used for position fixing enroute separation, approach, holding or ground speed calculation. DME-equipped aircraft may be authorized to carry out an approach without the outbound headings and procedure turns necessitated by other instrument approach procedures. A DME fix may be obtained by referring the DME readout to the RMI. DME indication would then be the number of miles from the station along the indicated radial.

Tacan ground stations have the capability to reply to DME interrogation signals and also to transmit bearing information and identification signals. DME utilizes only the distance capability of TACAN, VOR being used for bearing information. VORTAC stations provide TACAN distance capability plus bearing information from both VOR and TACAN, thus providing range and bearing information for aircraft equipped with DME and VOR equipment.



DME Controls
Figure 3

B. Operation (Continued)

DME operation can be divided into two distinctly separate conditions: search and track. During search, the DME indicator dials will be masked and rotating in search. With the search complete, the mask is removed, indicating lock-on, and the slant distance to the ground station is shown on the indicators in nautical miles. The search switch, when in the OVERRIDE position, permits the DME to range beyond the 50-mile limit on short-range channels (TVOR and ILS).

The VOR/DME control switch, identified T/R-REC-OFF, performs two functions; in the OFF position, neither DME or VOR operation is provided. In REC position, VOR reception is available and DME is on standby. In T/R, both VOR and DME functions are available. In standby, the DME is turned on but is not transmitting and the ranging mechanisms are not constantly searching, eliminating unnecessary wear on system components, while allowing the pilot to put the DME into operation without the 2-minute warmup period.

To prevent interaction between DME and ATC, both equipments using L-band, and external suppression cable is connected between the two transponders to disable the ATC receiver position when DME is transmitting or, conversely, to disable the DME decoder when the ATC is transmitting.

C. Power

Aircraft power requirements for the DME are 115-volt a.c. and 28-volt d.c.

Power Sources

The circuit-breakers for the radar systems are located on the radio junction box. The power sources and circuit-breakers are as follows:

(1) Constant-frequency A.C.	Quantity	
Alt	1	*Not used
Radar (weather)	1	
ATC (621A-3)	1	
DME	1	
(2) D.C.		
Radar (weather)	1	
DME	1	

Radio Navigation

The radio navigation equipment consists of radio compass, VOR/ILS and marker receiver.

The aircraft is equipped with two complete ADF systems: The DF 202 for ADF1 and the DF 2071 for ADFZ.

Radio Compass

The DF-202 radio compass systems provide automatic direction finding (ADF) in the frequency range of 90 to 1800 kc. This range is covered in four bands. Tuning and band selection is done electrically from a remote control unit. Visual indication of station bearing is presented on the RMI of the gyro magnetic compass system.

The DF-2070 system provides the same services as the DF-202 except the tuning and band selection is accomplished within the self contained unit. Visual indication of station bearing is also presented on the DMI of the gyro magnetic compass system.

A. Components and Locations

The components and their locations are as follows:

Component	Location
Control Unit (2)	Pilots Overhead Panel and Captains Center Panel
Marker/ADF Selector Panel	Pilots Overhead Panel
ADF Receiver (2)	1 Aft Hold, 1 Captains Center Panel
Loop Antenna (2)	Bottom Fuselage
Sense Antenna (1)	Bottom Fuselage
Sense Antenna Coupler (1)	Aft Hold (Mounted on Receivers)
Rotary Solenoid Selector Switch (1)	Radio Junction Box
Radio Magnetic Indicator (2) (Gyro Magnetic Compass System)	Pilots, Co-pilots

Radio Compass (Continued)

B. Controls (DF-202)

The 614L-6 control unit provides the following controls (Ref. Fig. 4):

a) Gain Control

b) BFO Switch.

c) Broad or Sharp Filter Selection.

d) Tuning Knob (hundreds)

e) Tuning Knob (tens)

f) Tuning Knob (units)

g) Loop L-R Switch.

h) Function Selector Switch.

A tuning meter provides an aid in tuning for maximum signal. Tuning is done by means of three controls which provide selection of the frequency in hundreds, tens and units of kc. A BFO on/off switch controls a beat frequency oscillator operating at 456.72 kc, which heterodynes with the 455.70 kc intermediate frequency, providing a beat note of 1020 cycles.

The DF-2070 unit has the following controls (Ref Fig. 4A):

a) Volume Control

b) Filter Selection

c) Tuning Knob (Thousands)

d) Tuning Knob (Hundreds)

e) Tuning Knob (Tens)

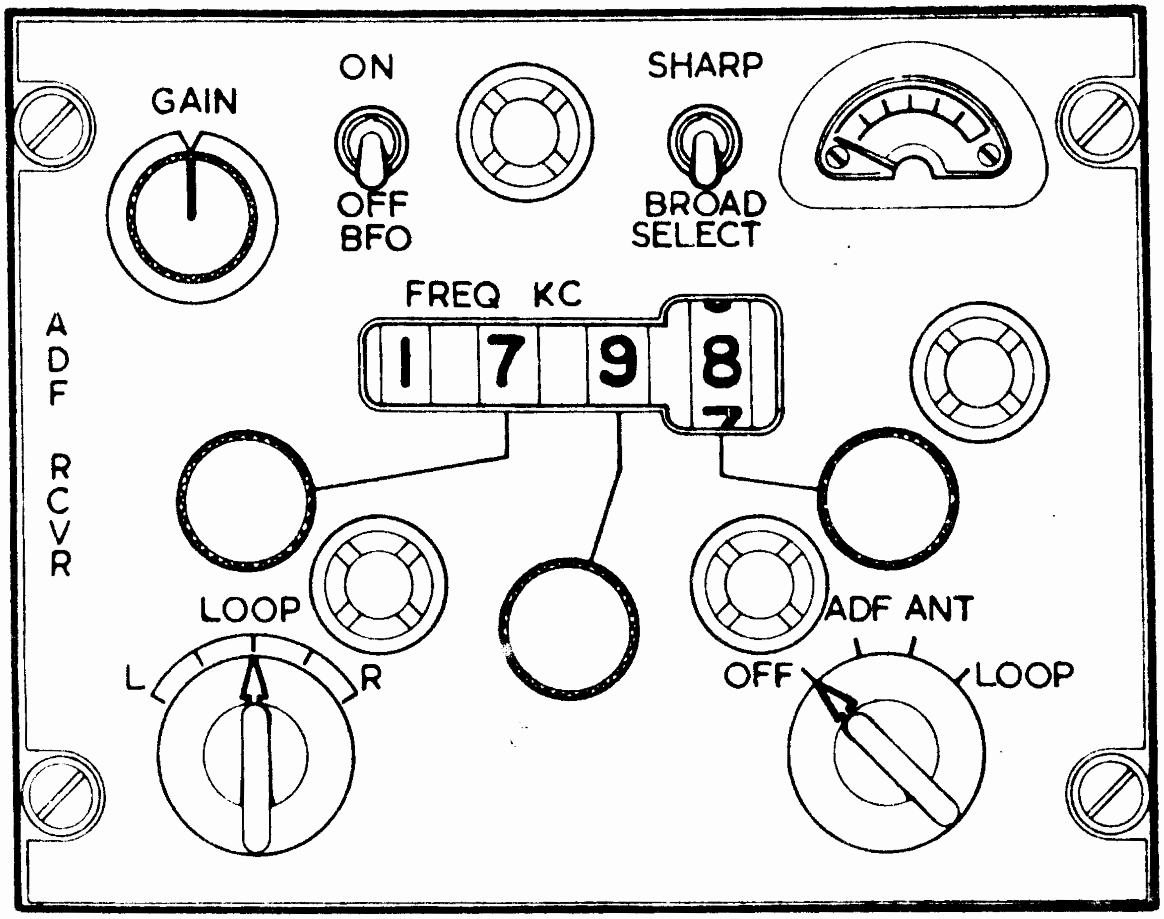
f) Tuning Knob (Units)

g) Function Selector Switch

Tuning is done by means of four controls which provide selection of the frequency in thousands, hundreds, tens, and units of kc. The Function Selector Switch allows for BFO, ADF, or extended range use.

C. Indicators

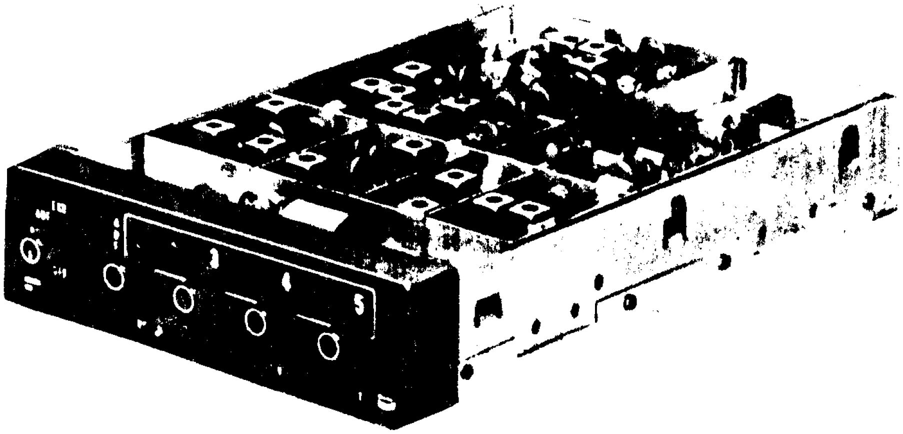
The two RMIs serve as radio compass indicators. Each pointer in an RMI receives information from the loop antenna assembly. The single pointer represents the ADF1 system, the double pointer represents the ADF2 system.



614L-6

44D4 OM 18-7

Radio Compass Control Panel
Figure 4



DF - 2070
BENDIX ADF

Figure 4A

INTENTIONALLY
LEFT
BLANK

Radio Compass (Continued)

D. Power

Both systems are fed from the aircraft 115-volt 400-cycle a.c. and the 28-volt d.c. systems.

VOR/ILS System

The VOR/ILS is a radio navigational aid which provides, through receiving and computing of VHF signals, visual indication of bearing and elevation of the aircraft in relation to the VOR or ILS ground station to which the system is tuned. The information is displayed on the flight instruments via the integrated director system.

The system operates in two modes, VHF omni-range (VOR) and instrument landing system (ILS). In VOR, it determines aircraft bearing by comparing the phase of modulation of two signals from a VOR ground station. In ILS, it detects vertical and lateral deviation from an approach and glide path by comparing the strength of signals radiated in two pairs of narrow beams.

The aircraft is equipped with two complete VOR/ILS sytems, VOR1 and VOR2, which display their information on the pilots and co-pilots flight instruments respectively. The instruments used in either position are the approach horizon and the course indicator of the IDS and the radio magnetic indicator (RMI) of the gyro magnetic compass system. Reception of signals on the omni-range, localizer and glide slope frequencies is limited to the line of sight.

A. Operation

The system operates in two different modes, VOR or ILS, depending on the selected channel. When VOR channels are selected, the system determines the phase difference between two 30-cycle signals, which is a function of the aircraft bearing with respect to the VOR ground station. When tuned to a localizer channel the system compares the strength of two signals, one modulated with a 90-cycle and the other with a 150-cycle signal, radiated in two nearly parallel narrow beams with their center or beam-overlap in line with the runway. Coincident with the localizer channel, a glide slope channel is selected which determines deviation from the glide slope by comparing two similar beams radiated in the vertical plane of the runway approach.

Omni-range channels are at even tenths of a megacycle in the frequency range 108.00 to 111.8 mc or any frequency in the range from 112.0 to 117.9 mc. Localizer channels are reserved within this range, at odd tenths of a megacycle, from 108.00 to 111.90 mc. The frequency range for glide slope channels is the UHF region from 329.60 to 335.00mc. Pitch and heading deviation signals are also fed into the auto pilot system.

VOR/ILS System (Continued)

B. VOR Operation

With the receiver tuned to a VOR channel, the VOR/ILS system enables the pilot to select, identify and maintain a predetermined course with reference to the selected VOR ground station.

During VOR operation, the ILS/HDG switch on the approach horizon must be in the HDG position. The course indicator displays a manually selected heading with respect to the VOR ground station by means of the course arrow, and deviation from the selected course by means of the course bar which is part of the course arrow. A steering command signal is displayed on the approach horizon by means of the steering pointer.

C. ILS Operation

The ILS ground station transmits two narrow beams in lateral and vertical plans, the lateral indicating the runway heading and the vertical indicating the glide slope towards the runway. The lateral beams are referred to as localizer beams, the vertical beams as the glide slope beams. The localizer beams are VHF transmissions, the left beam modulated with 90 cycles and the right beam with 150 cycles. The glide slope beams are UHF transmissions, the upper beam modulated with 90 cycles and the lower beam with 150 cycles. The beams overlap slightly on the ideal approach and glide slope. Deviation of the aircraft is indicated by means of the course bar and also by the steering pointer and glide slope pointer on the approach horizon. During ILS operation, the ILS-HDG switch on this indicator must be in the ILS position.

D. Components and Locations

The components and their locations are as follows:

Components	Location
Glide Slope Receiver (2)	Navigators Station
Instrument Unit (2)	Navigators Station
VHF Receiver (2)	Navigators Station
Control Unit (2)	Pilots Center
Switch Panel (1)	Pilots Overhead Panel
Glide Slope Antenna (1)	Nose Radome

VOR/ILS System (Continued)

D. Components and Locations (Continued)

Components	Location
VHF-LOC Antenna (1)	Upper Fuselage (Flight Compartment)
IDS Selector Switch (Rotary Solenoid)	Forward Hold

E. Glide Slope Receiver

The Collins 51V-3 glide slope receiver is a self-contained airborne single-conversion superheterodyne receiver operating in the frequency range 329.60 to 335.00 mc. It is designed to give vertical guidance to a pilot in his final approach towards the runway and picks up signals from a glide slope transmitter adjacent to the runway. The selection of the 10 glide slope channels, which are spaced 600 kc apart, is coincident with the selection of localizer channels.

F. Instrumentation Unit

The instrumentation unit 344B-1 computes the signals from the VHF receiver by means of amplifiers, servo motors, synchros and descriminator circuits. The unit is powered from the aircraft a.c. and d.c. systems.

The modulation phase of the FM reference signal from the VHF receiver is compared with that of the variable-phase signal. This phase difference is interpreted in the instrumentation unit into heading and deviation information which is fed to the course indicators via the integrated director system and the radio magnetic indicators of the gyro magnetic compass system.

In ILS operation the instrumentation unit handles the lateral guidance signals from the ILS ground station. The 90-cycle and 150-cycle guidance signals are fed, via filter circuits, to the steering pointers of the approach horizons of the IDS. The same information is also fed to the course bar of the course indicator.

G. Control

(1) The Gables frequency control unit is a panel-mounted control having a power on-off switch, megahertz frequency control, kilohertz frequency control, volume and a window indicator to show the selected frequency (Ref. Fig. 5).

VOR/ILS System (Continued)

G. Control (Continued)

When the on-off switch is switched to ON, the power relay is connected to ground and this switches 28-volt d.c. and 115-volt a.c. to the VHF receiver, glide slope receiver and instrumentation unit of the particular VOR system.

The control contains megahertz frequency control and kilohertz frequency control. These controls select the frequency and also operate digits to indicate the selected channel. The frequency selection of the VHF receiver is coincident with the frequency selection of the glide slope receiver when the former is tuned to a localizer channel.

A three-position toggle switch on the pilot's overhead panel transfers VOR2 information from the co-pilot's IDS to the Pilot's IDS when EMERG is selected and disconnects the VOR2 receiver from the VOR system to serve as a communication receiver when COMM is selected.

2. The gables frequency control unit utilized for VOR/ILS/DME operation, is a panel-mounted control having a ON-OFF control switch, MHz frequency control, KHz frequency control, volume control and a window indicator to show the selected frequency, and a search override switch marked NORMAL-OVERRIDE used for DME operation and a DME hold switch. For information on DME, refer to Distance Measuring Equipment this section.

H. IDS Selector Switch

The IDS selector switch is a rotary solenoid in the forward hold. When the VOR2 selector switch is set to EMERG, the IDS selector switch disconnects the VOR2 information circuits from the co-pilots integrated director system (IDS) and connects them to the pilots IDS.

Marker Receiver

The marker receiver system indicated reception of marker beacon signals from airways fan markers, station locator Z markers and approach markers of an instrument landing system by means of colored indicator lights and audio tones. The aircraft installation consists of an antenna, receiver, HI-OFF-LO sensitivity switch, and marker lights. The receiver detects 75-mc signals received from ground transmitters positioned at points along airways and at standard distances along the approach to a given runway. These signals in order of approach, are the airway markers, then the ILS outer and inner markers, which are modulated with 3,000, 400, and 1,300 cycle tones respectively, each identifying the transmitter and therefore the location.

Marker Receiver (Continued)

For aural indication the receiver audio output is fed to the intercom. The receiver also controls white, blue, and amber indicators (at both the pilots and co-pilots station) which light to indicate the airway, outer, and inner markers respectively. High or low sensitivity is selected at the pilots overhead panel.

A. Components and Locations

The components and their locations are as follows:

Component	Location
Marker Receiver	Navigators Rack (Lower)
Antenna	Bottom Fuselage (Forward Hold)
Marker/ADF2 Selector Panel)	Pilots Overhead Panel
Marker Light (3) (Pilot)	Pilots Instrument Panel
Marker Light (3) (Co-pilots)	Co-pilot Instrument Panel

B. Controls

The only operating control for the marker beacon is that provided by the HI-OFF-LO sensitivity switch (marker/ADF2 selector panel) mounted on the pilots overhead panel.

C. Marker Lights

The pilots and co-pilots indicator lights are connected to a lamp test circuit in the receiver and each light may be tested by pressing the holder.

Power Sources

The circuit-breakers for the radio navigation systems are located on the radio junction box. The power sources and circuit-breakers are as follows:

(1) Constant-frequency A.C.	Quantity
ADF1	1
ADF2	1
VOR/ILSI - Inst. Unit	1
VOR/ILSI - Recvr	1
VOR/ILS2 - Inst. Unit	1
VOR/ILS2 - Recvr	1
VOR/ILS1 - Glide Path	1
VOR/ILS2 - Glide Path	1

Power Sources (Continued)

(1) Constant-Frequency A.C.

	Quantity
Marker	1

(2) D.C.

ADF1	1
ADF2	1
VOR/ILS1 - Inst. Unit	1
VOR/ILS1 - Recvr	1
VOR/ILS2 - Inst. Unit	1
VOR/ILS2 - Recvr	1
VOR/ILS1 - Glide Path	1
VOR/ILS2 - Glide Path	1
Marker	1

Communication Systems

The communications systems installed in the aircraft consist of the following equipment:

(1) Two high frequency communication systems with control units on the pilots overhead panel and

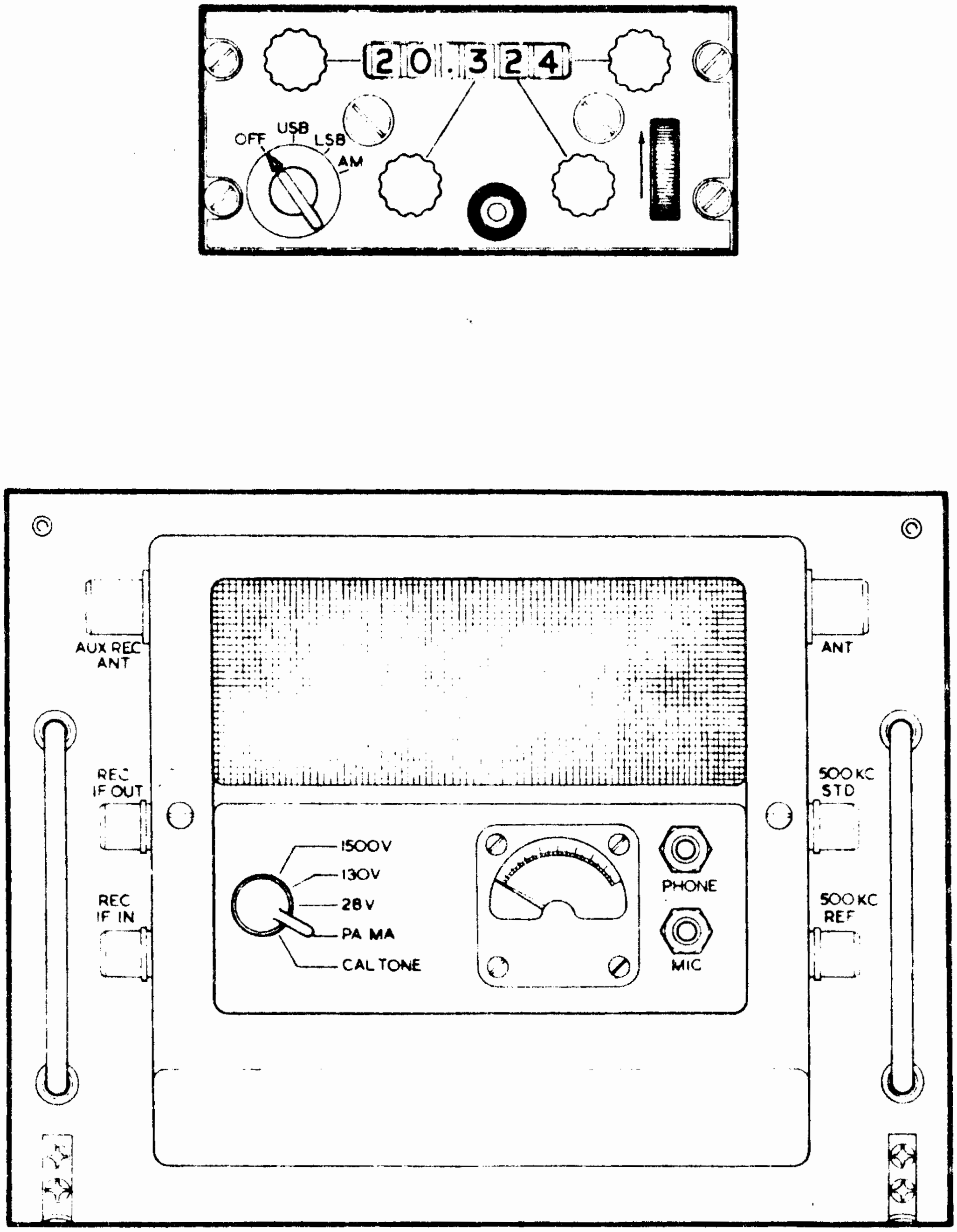
(2) Two very high frequency radio communication systems one with control unit on the pilots overhead panel and dual control heads for number 2 communication system on co-pilot's center panel.

(3) An intercom system combining interphone and audio integrating functions in the same unit are located at the pilots, co-pilots, check pilots, systems operators and navigators stations and extending interphone facilities are located at aft cargo attendants station and a nose wheel well station.

Control panels are illuminated independently of equipment operation. Panel light dimmers are located on the pilots overhead panel (for pilots and co-pilots controls), systems operators panel (for check pilots intercom), systems operators fuel management and pressure panel (for systems operators intercom), and navigators panel (for navigators controls).

Cabin air is sucked through the electronic equipment in the navigators rack by a cooling fan and exhausted into the forward hold, from which it is vented to atmosphere. The fan is energized directly from the three circuit-breakers on the main distribution panel.

Static discharges are installed to reduce static discharge accumulated



44D4-OM-18-1B

HF Radio Transceiver and Control
Figure 6

Communications Systems (Continued)

by the aircraft in flight. Each discharger consists of a flexible plastic sheath containing a conducting wick. At the free end, the wick is exposed and fanned out, and at the other end it is enclosed in an aluminum tube. This tube is flattened and is attached to the aircraft with two machine screws.

High Frequency (HF) Communication Systems

The 618T-2HF systems provide long-range radio communication in the 2 to 30 magacycle frequency range and operates on any one of 28,000 selectable frequencies at 1-kc increments. Transmission and reception may be made in the single-sideband (SSB) or aimplitude-modulation (AM) mode.

The HF aircraft installation consists of two independent identical radios HF1 and HF2, each consisting of a transceiver and control unit (Ref. Fig. 6). Both sets use the fin cap antenna. Both can receive at the same time but only one transmits at a time. The HF systems are designed for radio silence operation.

A. Components and Locations

The components and their location are as follows:

Component	Location
Control Units, HF1 and HF2 (2)	Pilots Overhead Panel
Transceiver, HF1 and HF2 (2)	Navigators Station (Lower Rack)
Coupler Accessory Units No. 1 (HF1) and No. 2(HF2) FT, SL, SW 31 and 32)	Rear Cabin No. 1 Port, NO. @ Starboard Side
Coupler Accessory Units No. 1 (HF1) and No. 2(HF2) SW14, 23,26,27, and 30)	Aft side of aft pressure bulkhead
Antenna Relays and Lightning Arrester	Vertical Stabilizer
Antenna	Fin Cap
Antenna Coupler No. 1	Vertical Stabilizer
Antenna Coupler No. 2	Vertical Stabilizer

B. Controls

The 714E-1 unit contains all the controls to operate the 618T-2 transmitter (Ref. Fig 6) Two control units are located on the pilots overhead panel, one for HF1 and one for HF2.

The front panel contains the following:

(1) Four frequency controls; megacycles, 100kc, 10kc, and 1kc.

(2) A window through which digits are visible to show the actual frequency selected.

(3) An RF gain control.

(4) A switch on which OFF, USB (upper sideband), LSB (lower sideband), and AM (amplitude modulation) modes may be selected.

C. HF Coupling System

The AT-102 tuning system couples the HF1 and HF2 sets to the fin cap antenna. Both HF1 and HF2 can receive at the same time, but only one can transmit at a time. The tuning system consists of coupler accessory unit No. 1(HF1) and No. 2(HF2), a antenna coupler No. 1(HF1) and No. 2(HF2), and the lightning arrester and antenna relays (common to HF1 and HF2). Connection is made to the fin cap antenna via the lightning arrester and antenna relays.

D. Antenna Coupler

The 180R-4 antenna coupler contains the antenna loading and phasing elements, and the associated driving motors, for resonating the antenna and matching the antenna impedance to that of the transmitter. A phasing and loading discriminator detects changes (errors) in phase and loading, and the outputs from the discriminator, when amplified, drive the antenna coupler motors to reduce the error to zero. One coupler is provided for each HF system. The 180R-4 is not a constant surveillance system. To re-tune the antenna system, the frequency must be reselected.

DA. Operating Procedure for Antenna Tuning

The tuning indicator light on the control unit is for antenna tuning only and does not indicate tuning of the transceiver. When the tuning indicator light goes out after a new frequency is selected, the system is ready for reception only. This is a part of radio silence operation: the antenna system cannot tune itself without transmitting a signal, and is therefore not permitted to do so until the press-to-talk button is used. The press-to-talk button triggers the antenna tuning cycle, causing the tuning indicator light to come on while the motor-driven switch in the accessory

DA. Operating Procedure for Antenna Tuning (Continued)

unit is in RF-on and tune positions. At the same time, the blower motor in the transceiver should be heard to speed up. The light goes out when the motor-driven switch reaches the operate position, and the system is now ready for both receive and transmit.

When a fault occurs that threatens to overhead the accessory unit or the antenna coupler, the tuning indicator light comes on, or remains on when it is normally expected to go out. In this event, the unit must be given time to cool before re-tuning is attempted. To re-tune, another frequency must be selected and the talk button pressed momentarily. The desired frequency can then be reselected.

E. Antenna System Pressurization

Air from the main cable is fed through a dehydrator (near the rear bulkhead) and through an air supply line to the lightning arrester and relay unit and to each antenna coupler, thus maintaining these units at cabin pressure.

F. Intercom Facilities

HF1 or HF2 is selected on the A81-2 intercom control panels (Ref. Fig. 8).

G. Power

Power requirements for the system are 115-volt a.c. and 28-vold d.c. from the aircraft supply. The following refers to the HF1 system; HF2 is similar.

The 115-volt a.c. is supplied from three circuit-breakers, phase A, phase B and phase C; these supplies are connected to the transceiver connections 1, 2 and 3 respectively. An additional feed is taken off the phase A circuit-breaker to supply the transceiver (in HF2, this additional feed is taken off the phase B circuit-breaker).

The 28-volt d.c. is supplied to the transceiver, and to the transmit relay for transmitter keying. When this relay is energized by pressing the microphone button, it connects a ground to the key line of the transceiver and to its coupler accessory unit.

Very High Frequency (VHF) Communication Systems

The VHF systems provide amplitude-modulated voice communication from aircraft to ground or aircraft to aircraft. Transmission is provided on 680 channels space 50 kc apart in the frequency range 118.00 to 151.95 mc. Communication is normally limited to line-of-sight distance and the average communicating range from aircraft to ground is approximately 30 miles at 1,000 feet and 135 miles at 10,000 feet.

Very High Frequency (VHF) Communication Systems (Continued)

The VHF aircraft installation consists of two independent radios, VHF1 and VHF2. VHF1 consists of a transmitter, a receiver, and a frequency control unit. VHF2 consists of a RX and TX combined in one unit.

Each radio has single-channel simplex (SCS) and double channel simplex (DCS) operation. The frequency desired for either radio is selected on the appropriate control panel (pilots overhead panel) where visual indication of selected frequency is provided. In single-channel operation the frequency range is 118.00 to 151.95 mc in 50-kc increments. In double-channel operation the frequency range of the transmitter is 124.00 to 126.95 mc and 133.00 to 135.95 mc in 50-kc increments, the receiver being tuned 6 mc lower than the transmitter. The control unit indicates the receiver frequency.

Two coaxial relays are energized when the VOR2 selector switch on the VOR2 transfer control panel is set to COMM transferring the VOR2 receiver to the VHF2 receiver section of the antenna. VOR2 receiver therefore replaces VHF2 receiver in this mode of operation. A contact of the VHF2 transmit relay is wired to the VOR2 system so that the VOR2 receiver is disabled when VHF2 is transmitting with the VOR2 selector switch to COMM.

A. Components and Locations

The components and their locations are as follows:

Component	Location
Control Unit No. 1	Pilots Overhead Panel
Control Unit No. 2	Co-pilots centre panel
VHF1 Transceiver	Forward Hold
VHF2 Transceiver	Navigators Rack
VHF 1 Antenna	Bottom Fuselage (Forward Hold)
VHF2 Antenna (Combined VHF and Localizer)	Upper Fuselage (Flight Compartment)

B. Frequency Control Unit

The control unit is a panel-mounted control having a power on-off switch, MHz frequency control, KHz frequency control, volume control, and an

B. Frequency Control Unit (Continued)

illuminated window showing digits to indicate the frequency. Five digits are visible in the indicator window, the first three digits indicating megacycles and the other two indicating kilocycles. The two frequency control knobs select a digit combination for any desired communication channel.

C. Power

The VHF1 and VHF2 radios require 28-volt d.c. and 115-volt a.c. from the aircraft supply. This power is supplied to both radios through eight circuit-breakers.

Audio Integrating (Intercom) System

The intercome system provides interphone facilities between crew stations in the aircraft, and also provides integration of the interphone, communications radio and navigations radio systems. Call facilities are provided for aural signalling between stations, and an interphone extension connector is installed in the nose wheel well for ground crew use in servicing the aircraft.

A. Components and Locations

The components and their locations are as follows:

Component	Location
A81-2 Control Unit	Pilots Station Co-pilots Station Check Pilots Station Systems Operators Station Navigators Station
A81-2 Control Unit	Nose Wheel Well Aft Cargo Attendant
Two-way Switch	Pilots Control Column Co-pilots Control Column
Interphone Connector	Nose Wheel Well
Headset Connector	Pilots Station Co-pilots Station Check Pilots Station Systems Operators Station Navigators Station Aft Cargo Attendant Nose Wheel Well

Audio Integrating (Intercom) System (Continued)

B. Intercom Facilities

For a table showing the intercom facilities at each station, refer to Figure 8.

C. Power

The A-81 intercom system is fully transistorized and operates on 28-volt d.c. which is supplied from the aircraft d.c. buses through circuit-breakers on the radio junction box. Power switches are not provided and the intercom system is always energized when power is applied to the aircraft essential and main d.c. buses.

D. Controls (Ref. Fig. 9)

The intercom system is designed to provide a comfortable listening level on interphone when the main I/C volume control is in the vicinity of the 12 o'clock position. For best results and to decrease the susceptibility to cross-talk, the individual monitor volume controls should be maintained around the 3 o'clock position when the receiver colume controls are adjusted to a comfortable listening level. Three types of control units are used:

E. A-81-2 Control Unit

(1) Monitor Switches

Eight pull-on, push-off monitor switches are installed on the front panel. Switches 2 to 7 have a volume control coupled to the rotable shaft of each switch. Switch 1, used for interphone, has no volume control, hence only the master volumne control affects the interphone audio level. Switches 2, 3, 4 and 5 are coupled to the VHF1, VHF2, HF1 and HF2 radio receivers respectively. Switch 6 is for PA reception on LL aircraft only. Since PA facilities are not required on other aircraft, the wire is terminated in the radio junction box. Switch 8 is not used for monitoring and, in the pilots, co-pilots and systems operators positions, is used to select hot mike talk facility.

(2) Selector Switch

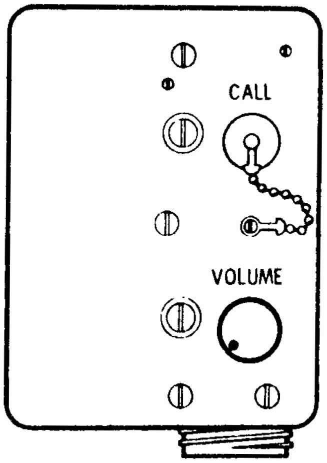
The selector switch has six positions. Position No. 1 is for PA control (LL aircraft only). Positions 2 to 5 are for radio transmitting facilities. Positions 2 to 6 also parallel their respective monitor switches so that it is not necessary for the related monitor switch to be on to listen. Position 6 is for inter-

		STATION						
		PILOT	CHECK PILOT	CO-PILOT	SYSTEMS OPERATOR	NAVIGATOR	AFT CARGO ATTENDANT	NOSE WHEEL WELL
A81-2 CONTROL UNITS - SELECTOR SWITCH POSITION	1	PA/	SPARE	SPARE	SPARE	SPARE		
	2	HF2	HF2	HF2	HF2	HF2		
	3	HF1	HF1	HF1	HF1	HF1		
	4	VHF2	VHF2	VHF2	VHF2	VHF2		
	5	VHF1	VHF1	VHF1	VHF1	VHF1		
	6	INTER	INTER	INTER	INTER	INTER		
A81-2 CONTROL UNITS - MONITOR SWITCHES	1	INTER	INTER	INTER	INTER	INTER		
	2	VHF1	VHF1	VHF1	VHF1	VHF1		
	3	VHF2	VHF2	VHF2	VHF2	VHF2		
	4	HF1	HF1	HF1	HF1	HF1		
	5	HF2	HF2	HF2	HF2	HF2		
	6	PA	PA	PA	PA	PA		
	7	SPARE	SPARE	SPARE	SPARE	SPARE		
	8	HOT MIKE		HOT MIKE	HOT MIKE			

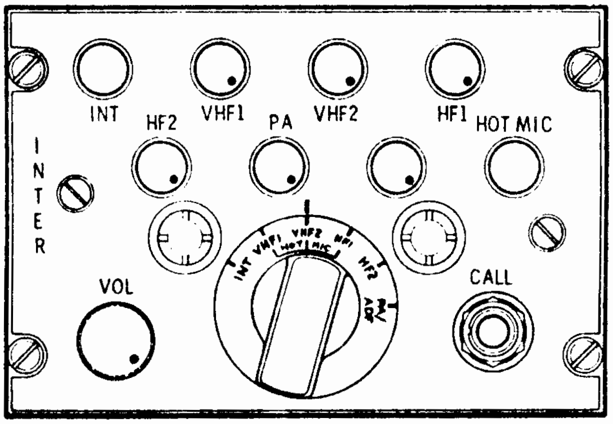
Table of Intercommunication Facilities
Figure 8 (1 of 2)

		STATION						
		PILOT	CHECK PILOT	CO-PILOT	SYSTEMS OPERATOR	NAVI-GATOR	AFT CARGO ATTEN-DANT	NOSE WHEEL WELL
A81-4 CONTROL UNITS - MONITOR SWITCHES	9	ADF1	ADF1	ADF1		ADF1		
	10	ADF2	ADF2	ADF2		ADF2		
	11	VOR1	VOR1	VOR1		VOR1		
	12	VOR2	VOR2	VOR2		VOR2		
	13	MARKER	MARKER	MARKER		MARKER		
	14	ATC	ATC	ATC		ATC		
	15	SPARE DME*	SPARE DME*	SPARE DME*		SPARE DME*	*Aircraft 9 & 39	
	16	SPARE	SPARE	SPARE		SPARE		
A81-1 CONTROL UNITS							INTER	INTER
HOT-MIKE FACILITIES		VHF1		VHF1	VHF1			
		VHF2		VHF2	VHF2			
		HF1		HF1	HF1			
2 WAY SWITCH		INTER/TRANS		INTER/TRANS				

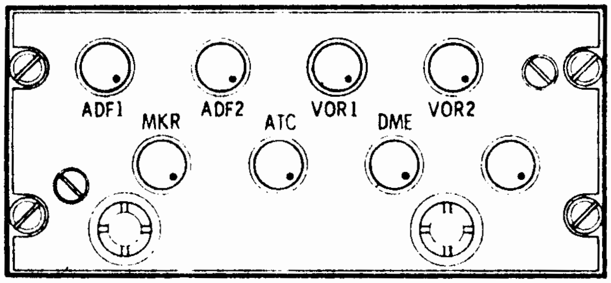
Table of Intercommunication Facilities
Figure 8 (2 of 2)



A81-1



A81-2



A81-4

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Intercommunication Control Units
Figure 9

Audio Integrating (Intercom) System (Continued)

(2) Selector Switch (Continued)

phone talk and positions 3, 4 and 5 are for interphone HOT-MIC operation. The separate sections perform the following functions:

(a) Connect the output from the microphone amplifier to the appropriate private circuit.

(b) Select the transmitter control circuit.

(c) Provide for hot-mike operation (in positions 3, 4 and 5).

(d) By-pass the monitor switches to provide for listening in two-way radio operation.

(3) Hot-mike Operation

Hot-mike operation is available at the pilots, co-pilots and systems operators stations and permits the operator to talk over the interphone system without using a talk switch. Hot-mike facilities are selected when the selector switch is in the HF1, VHF1, or VHF2 positions and monitor switches 8 and 1 are on.

Radio receiving facilities are also selected in these positions of the selector switch, thus the operator can use his selector switch for the appropriate radio receiver channel and simultaneously listen on interphone by using his interphone minitor switch. Receiver facilities are not affected by hot-mike operation, and the operator can talk on the interphone without interrupting the incoming signals. However, when the operator uses his press-to-talk switch or places the control column switch to TRANS, the hot-mike feature is disabled and he obtains normal talk and sidetone operation for the selected radio transmitter.

(4) Call Button Operation

When the call button is pressed, audio from the calling station is superimposed on the existing signals at all other stations without interrupting the signals, hence the push-button call switch enables the operator to override all other activity in the system and issue emergency communications.

F. A81-4 Control Unit

The A81-4 control panel is used in conjunction with the A81-2 control unit and provides facilities for monitoring eight services in addition to those

Audio Integrating (Intercom) System (Continued)

F. A81-4 Control Unit (Continued)

monitored by the A81-2 control. Each switch has a built-in volume control. The switches are used to select audio input from the aircraft navigation system.

G. A81-1 Control Unit

The A81-1 control unit has a push-button call switch and a volume control. It is used where only interphone facilities are required.

H. Control Column Switches

On-off-on toggle switches, engraved TRANS-INTER, are installed, one on the pilots control column and one on the co-pilots control column. Two modes of micrphone operation are possible when using these switches:

(1) In the INTER position, the operator may talk on the interphone system irrespective of the position of the selector switch. However, when he uses his press-to-talk switch, he disables his interphone facility and obtains normal transmitter operation.

(2) In the TRANS position, the operator may transmit on the service selected by the selector switch without using the talk switch on his microphone.

Power Sources

The power sources and circuit-breakers for the communication systems are as follows:

	Quantity
(1) Constant-frequency A.C. - Radio Circuit-breaker Panel	
HF1	3
(2) Constant-frequency - Panel B - MDP	
Radio Rack Cooling Fan	3
Radio Power B	3
(3) Constant-frequency - Panel A - MDP	
Radio Power A	3

Power Sources (Continued)

	Quantity
Radio Instrument Power No. 1 and No. 2	2
HF2	3
(2) D.C.	
HF2	1
VHF2 - Transceiver	1
Flight I/C2	1
Aux I/C	1
HF1	1
VHF1 - Transceiver	1
Flight I/C1	1

Navigation

The electronic attitude and direction instrumentation and the position computing equipment consists of the gyro magnetic compass system, the integrated director system (IDS) and the periscopic sextant.

Gyro Magnetic Compass System

The slaved gyro magnetic compass system provides visual indication of the magnetic heading of the aircraft. This heading is displayed on the radio magnetic indicators on the pilots, co-pilots and navigators instrument panels. The indication is derived from a gyro whose orientation in aximuth is slaved to the earths magnetic meridian by means of a magnetic-field sensing unit of flux valve.

Two independent systems are used, one for the pilot and one for the co-pilot.

The pilots compass system repeats heading data for use in the pilots IDS and VOR/ILS. The co-pilots compass system repeats heading data for use in the navigators RMI and co-pilots IDS and VOR/ILS.

The compass system selector switch, on the pilots instrument panel, provides selection of heading data for the pilots RMI from either the pilots gyro or a heading repeater in the co-pilots RMI.

The system can also operate as a free gyro compass by switching out the flux valve.

Gyro Magnetic Compass System (Continued)

A. Operation

A flux valve senses the direction of the horizontal components of the earths magnetic field and transmits this information to the flux valve synchro in the directional gyro.

The Y-connected secondary coils of this flux valve are wound around the three legs of a laminated metal core in the form of a spider. The induce voltages in the flux valve synchro located in the directional gyro. The strator windings of this synchro are fixed to the gyro housing and the rotor is coupled to the gyro gimbal. When the aircraft changes its heading, the direction of the earth's magnetic field at the spider coils changes, and therefore that of the magnetic field at the strators of the flux valve synchro in the directional gyro. At the same time, the gyro rotates in its casing and rotates the rotor of the flux valve synchro. The synchro therefore remains electrically assigned with the magnetic field.and the error voltage across the rotor remains zero. However, when the gyro drifts, an error signal across the rotor will, after amplification and phase detection, drive the slave torque motor to precess the gyro in its horizontal plane.

In the directional gyro the rotor of a heading synchro is mechanically coupled to the flux valve synchro rotor. The heading synchrc induces voltages in the stator windings of a synchro in the radio magnetic indicator. These voltages are amplified and used to drive a servo motor in the RMI which will turn the azimuth card until the output of the synchro is reduced to zero.

B. Components and Locations

The components and their locations are as follows:

Component	Location
Radio Magnetic Indicator (RMI) (3)	Pilots, Co-pilots and Navigators
A-2 Amplifier (2)	Systems Operators Station
J-2W Controller (2)	Pilots Overhead Panel

B. Components and Location (Continued)

Component	Location
Remote Magnetic Compensator (2)	Navigators Station
S3B or S3B/C Gyro (2)	Forward Hold
Flux Valve (2)	Port and Starboard Wing Tips
Compass System Selector Switch (1)	Pilots Instrument Panel
Compass Selector (Rotary Solenoid)	Forward Hold
RMI Servo Amplifier (2)	Instruments Panel Disconnect Brackets

C. J-2W Controller

The J-2W controller provides a means of operating the system as a magnetic heading (slaved gyro) or as a directional (free) gyro system, depending on the position of the MAG-DG selector switch. When the switch is set to DG, the flux valve is disconnected from the system and operation depends only on rigidity of the gyro. In magnetic heading operation, the gyro is automatically slaved to the flux valve at a rate of 2° to 5° per minute except in starting up the system, in which case the rate is of the order of 2° per second. Fast slaving can be introduced manually by means of the SET HEADING switch on the controller. This switch is intended for setting the gyro to a selected heading in the DG mode of operation, but works the same way in magnetic mode. It is not generally needed in magnetic mode, in which it is useful only when the gyro is over 5° out of alignment with the flux valve. An annunciator on the controller gives visual indication of alignment of the gyro with the flux valve. The sensitivity of this annunciator depends on the setting of the LDG-J-2 switch on the control panel, which requires to be set to J-2. Five degrees of misalignment will deflect the annunciator needle against the stop. For controller panel illustration, refer to Figure 12.

D. Radio Magnetic Indicator

The radio magnetic indicator (RMI) is a panel-mounted instrument which displays

D. Radio Magnetic Indicator (Continued)

magnetic heading and ADF and VOR bearings (Ref. Fig. 10). ADF or VOR indication is selected by means of a selector switch at the top left corner of the instrument. A flag warning indicates when power is switched off. The RMI also supplies heading data to the IDS and VOR systems.

Magnetic heading is indicated by a fixed lubber line against the servo-driven azimuth card. ADF1 and VOR1 bearings are indicated against the card by means of a single-barred pointer, ADF2 and VOR2 bearings by a double-barred pointer.

E. Remote Magnetic Compensator

The remote magnetic compensator compensates the flux valve output for magnetic variations which may occur around the location of the flux valve due to the aircraft magnetic fields originating from magnetic parts and electrical equipment. The compensator produces d.c. signals in each of the flux valve signal wires. A total of $\pm 10^{\circ}$ of correction can be obtained.

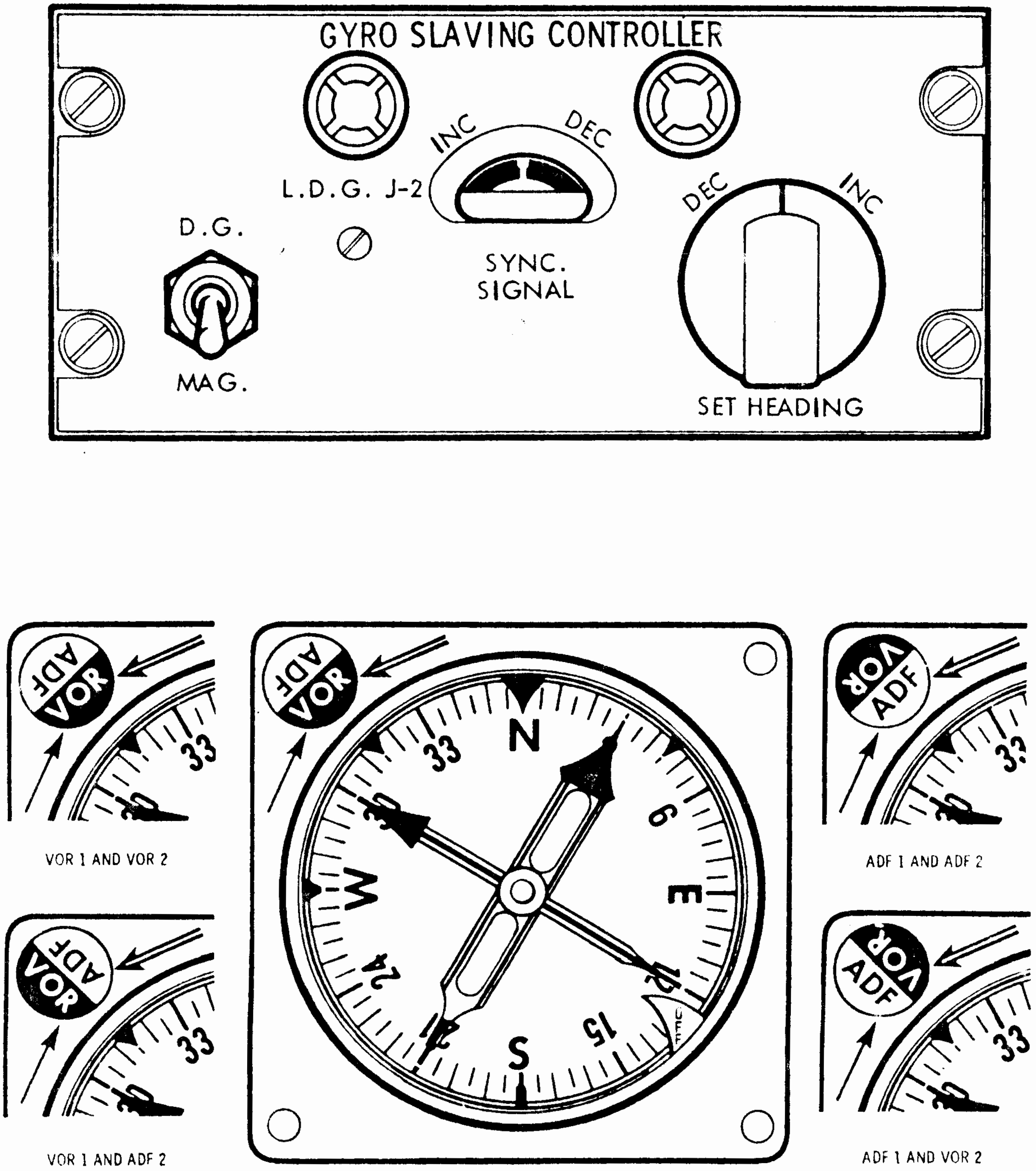
F. Directional Gyro

The directional gyro is controlled in azimuth by the flux valve while its spin axis is maintained in a horizontal plane by means of a liquid leveling switch. The gyro contains two synchros, with rotors linked to the azimuth gimbal and stators attached to the gyro housing. When the aircraft turns, the gyro housing rotates about the gimbal, changing the angle between the synchros stators and rotors. One synchros in each gyro supplies a heading signal to the servo synchro in the corresponding RMI. In the pilots system only, the second synchro supplies a heading signal to the auto-pilot system.

G. System Transfer

In case the pilots system directional gyro fails, the pilot can obtain information from the co-pilots system for his own indicator by selecting CO-PI on the compass system selector switch. This actuates the compass selector switch which disconnects the pilots gyro heading information from the pilots RMI and connects a repeater synchro in the co-pilots RMI to the pilots RMI.

When the pilots RMI is connected this way, the AG-DG switch on the pilots J-2W controller should be set to DG. If the switch remains at MAG, a portion of the servo loop is still active from the flux valve via the flux valve synchro (RMI) and A-2 amplifier to the slaving motor in the gyro. The servo synchro (RMI), however, determining RMI rotor position, receives its signal from the co-pilots system. As long as the rotor position fails to coincide with the flux valve synchro null, the gyro slaving motor is driven. Consequently, when normal operation is resumed, the gyro may be



VOR 1 AND VOR 2

ADF 1 AND ADF 2

VOR 1 AND ADF 2

ADF 1 AND VOR 2

44D4-OM-18-6A

J- Controller a adio Magnetic Indicator

Figure [illegible]

G. System Transfer (Continued)

found at some random heading remote from the heading required. This is avoided by switching to DG so that the gyro maintains heading by its own rigidity during transfer operation and will be close to the correct heading when normal operation is resumed.

Integrated Director System (IDS)

The integrated director system (IDS) provides a constant display of all information needed for ILS approaches and enroute navigation (Ref. Fig 11). Two identical integrated director systems are installed, one for the pilot and one for the co-pilot. The systems derive magnetic heading data from the magnetic compass system and radio navigational signals from the VOR/ILS systems.

The IDS provides the pilot with the following information:

(1) Roll and bank attitude with respect to a fixed reference (horizon).

(2) Pitch attitude with respect to a selected pitch reference.

(3) Magnetic heading of the aircraft.

(4) Selected magnetic heading error.

(5) Computed steering command.

(6) VOR bearings.

(7) Aircraft position relative to selected VOR radial.

(8) Aircraft position relative to glide slope.

(9) To-from indication relative to omni-range stations.

(10) Visual warning of unreliable information.

A. Operation

The ILS-HDG control knob on the approach horizon selects the ILS and HEADING mode of operation and actuates microswitches and relays for selection of the appropriate circuits.

(1) Heading Mode

The steering computer is fed with two signals, these being a bank signal from a bank synchro transmitter in the approach horizon and

A. Operation (Continued)

(1) Heading Mode (Continued)

an error signal from the selected heading synchro in the course indicator. When the heading marker, which is coupled to the selected heading synchro, does not coincide with the lubber line, indicating the aircraft being off heading, an error signal will appear across the rotor terminals of the synchro. When the aircraft drifts off its heading, a deflection of the steering pointer indicates the direction and amount of bank necessary to bring the aircraft back on its intended heading, which is obtained by banking the aircraft until the steering pointer is centered. Recovery of the selected heading will cause the steering pointer to deflect in the poopsite direction indicating that the amount of bank should be gradually reduced to keep the steering pointer centered. The output of the selected heading synchro is also fed to the auto pilot system.

When the course arrow on the course indicator indicates a VOR radial other than through the aircraft position and a VOR signal is received, a signal from the instrumentation unit will deflect the course bar and the TO-FROM indicator on the course indicator. The course bar deflection signal is generated by means of the course selector resolver, comparing VOR information with the bearing selected by the course arrow. The TO-FROM indicator shows the direction in which the aircraft is flying with respect to the VOR ground station. The course bar deviation will decrease when the aircraft is approaching the point of interception of the selected VOR radial. Course bar deviation signal is also fed to the auto pilot system.

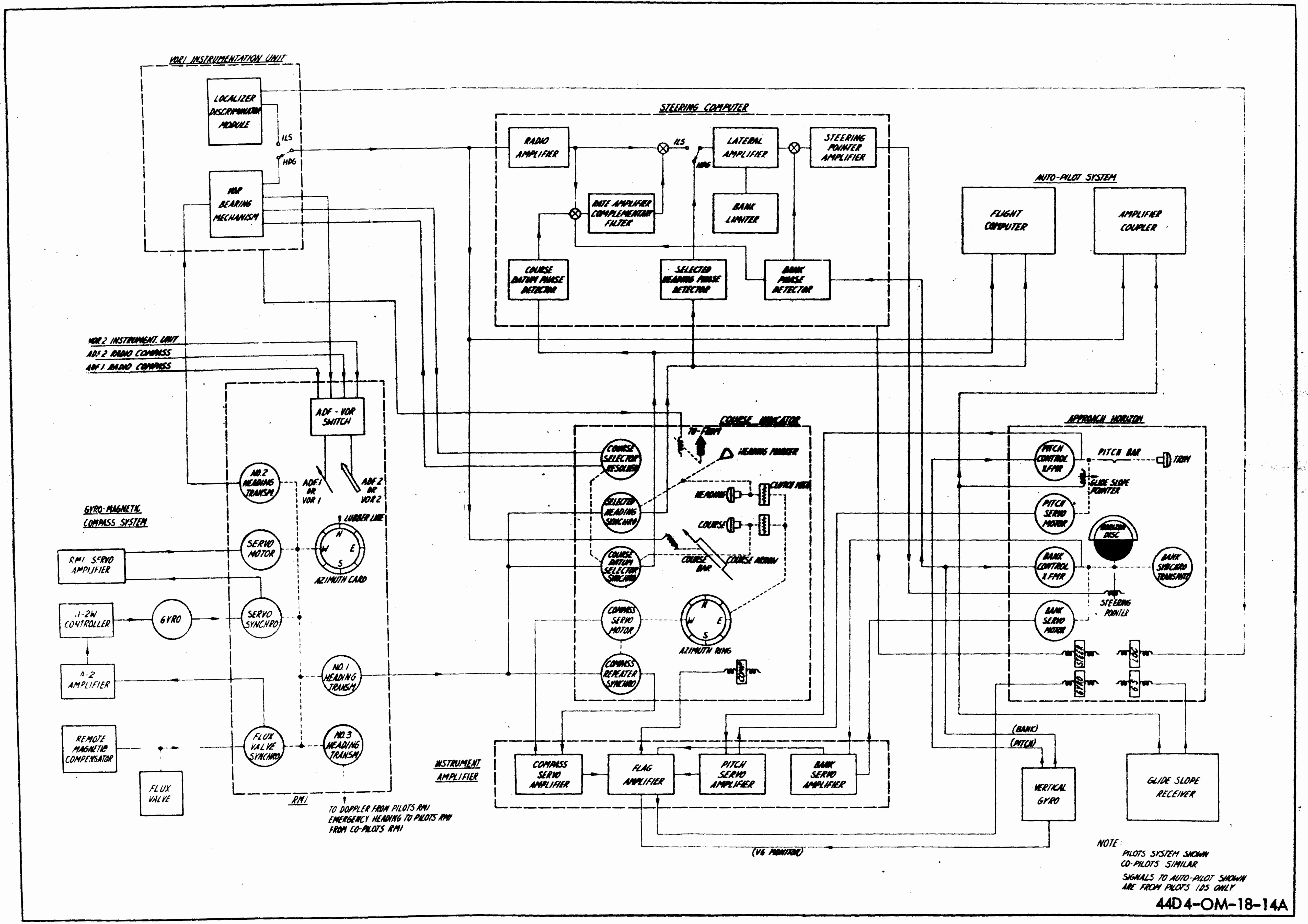
(2) ILS Mode

When it is desired to fly along a localizer course, ILS mode is selected on the approach horizon. The course arrow is set to the localizer course by means of the course control knob on the course indicator.

(3) Pitch and Bank Indication

Pitch and bank signals originate in the vertical gyro. When the pitch attitude of the aircraft changes, an error signal from the pitch synchro is applied to the pitch servo amplifier in the instrument amplifier, amplified, and used to drive the pitch servo motor in the approach horizon. The servo motor in turn drives the synchro rotor until it reaches a null position, when the pitch bar will indicate the pitch attitude of the aircraft.

The bank signal is applied to the bank synchro control transformer in the approach horizon. Any variation in bank attitude of the



Integrated Director System
Figure 11

Audio Integrating (Intercom) System (Continued)

F. A81-4 Control Unit (Continued)

monitored by the A81-2 control. Each switch has a built-in volume control. The switches are used to select audio input from the aircraft navigation system.

G. A81-1 Control Unit

The A81-1 control unit has a push-button call switch and a volume control. It is used where only interphone facilities are required.

H. Control Column Switches

On-off-on toggle switches, engraved TRANS-INTER, are installed, one on the pilots control column and one on the co-pilots control column. Two modes of micrphone operation are possible when using these switches:

(1) In the INTER position, the operator may talk on the interphone system irrespective of the position of the selector switch. However, when he uses his press-to-talk switch, he disables his interphone facility and obtains normal transmitter operation.

(2) In the TRANS position, the operator may transmit on the service selected by the selector switch without using the talk switch on his microphone.

Power Sources

The power sources and circuit-breakers for the communication systems are as follows:

	Quantity
(1) Constant-frequency A.C. - Radio Circuit-breaker Panel	
HF1	3
(2) Constant-frequency - Panel B - MDP	
Radio Rack Cooling Fan	3
Radio Power B	3
(3) Constant-frequency - Panel A - MDP	
Radio Power A	3

Power Sources (Continued)

	Quantity
Radio Instrument Power No. 1 and No. 2	2
HF2	3
(2) D.C.	
HF2	1
VHF2 - Transceiver	1
Flight I/C2	1
Aux I/C	1
HF1	1
VHF1 - Transceiver	1
Flight I/C1	1

Navigation

The electronic attitude and direction instrumentation and the position computing equipment consists of the gyro magnetic compass system, the integrated director system (IDS) and the periscopic sextant.

Gyro Magnetic Compass System

The slaved gyro magnetic compass system provides visual indication of the magnetic heading of the aircraft. This heading is displayed on the radio magnetic indicators on the pilots, co-pilots and navigators instrument panels. The indication is derived from a gyro whose orientation in aximuth is slaved to the earths magnetic meridian by means of a magnetic-field sensing unit of flux valve.

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The pilots compass system repeats heading data for use in the pilots IDS and VOR/ILS. The co-pilots compass system repeats heading data for use in the navigators RMI and co-pilots IDS and VOR/ILS.

The compass system selector switch, on the pilots instrument panel, provides selection of heading data for the pilots RMI from either the pilots gyro or a heading repeater in the co-pilots RMI.

The system can also operate as a free gyro compass by switching out the flux valve.

Gyro Magnetic Compass System (Continued)

A. Operation

A flux valve senses the direction of the horizontal components of the earths magnetic field and transmits this information to the flux valve synchro in the directional gyro.

The Y-connected secondary coils of this flux valve are wound around the three legs of a laminated metal core in the form of a spider. The induce voltages in the flux valve synchro located in the directional gyro. The strator windings of this synchro are fixed to the gyro housing and the rotor is coupled to the gyro gimbal. When the aircraft changes its heading, the direction of the earth's magnetic field at the spider coils changes, and therefore that of the magnetic field at the strators of the flux valve synchro in the directional gyro. At the same time, the gyro rotates in its casing and rotates the rotor of the flux valve synchro. The synchro therefore remains electrically assigned with the magnetic field and the error voltage across the rotor remains zero. However, when the gyro drifts, an error signal across the rotor will, after amplification and phase detection, drive the slave torque motor to precess the gyro in its horizontal plane.

In the directional gyro the rotor of a heading synchro is mechanically coupled to the flux valve synchro rotor. The heading synchro induces voltages in the stator windings of a synchro in the radio magnetic indicator. These voltages are amplified and used to drive a servo motor in the RMI which will turn the azimuth card until the output of the synchro is reduced to zero.

B. Components and Locations

The components and their locations are as follows:

Component	Location
Radio Magnetic Indicator (RMI) (3)	Pilots, Co-pilots and Navigators
A-2 Amplifier (2)	Systems Operators Station
J-2W Controller (2)	Pilots Overhead Panel

B. Components and Location (Continued)

Component	Location
Remote Magnetic Compensator (2)	Navigators Station
S3B or S3B/C Gyro (2)	Forward Hold
Flux Valve (2)	Port and Starboard Wing Tips
Compass System Selector Switch (1)	Pilots Instrument Panel
Compass Selector (Rotary Solenoid)	Forward Hold
RMI Servo Amplifier (2)	Instruments Panel Disconnect Brackets

C. J-2W Controller

The J-2W controller provides a means of operating the system as a magnetic heading (slaved gyro) or as a directional (free) gyro system, depending on the position of the MAG-DG selector switch. When the switch is set to DG, the flux valve is disconnected from the system and operation depends only on rigidity of the gyro. In magnetic heading operation, the gyro is automatically slaved to the flux valve at a rate of 2° to 5° per minute except in starting up the system, in which case the rate is of the order of 2° per second. Fast slaving can be introduced manually by means of the SET HEADING switch on the controller. This switch is intended for setting the gyro to a selected heading in the DG mode of operation, but works the same way in magnetic mode. It is not generally needed in magnetic mode, in which it is useful only when the gyro is over 5° out of alignment with the flux valve. An annunciator on the controller gives visual indication of alignment of the gyro with the flux valve. The sensitivity of this annunciator depends on the setting of the LDG-J-2 switch on the control panel, which requires to be set to J-2. Five degrees of misalignment will deflect the annunciator needle against the stop. For controller panel illustration, refer to Figure 12.

D. Radio Magnetic Indicator

The radio magnetic indicator (RMI) is a panel-mounted instrument which displays

D. Radio Magnetic Indicator (Continued)

magnetic heading and ADF and VOR bearings (Ref. Fig. 10). ADF or VOR indication is selected by means of a selector switch at the top left corner of the instrument. A flag warning indicates when power is switched off. The RMI also supplies heading data to the IDS and VOR systems.

Magnetic heading is indicated by a fixed lubber line against the servo-driven azimuth card. ADF1 and VOR1 bearings are indicated against the card by means of a single-barred pointer, ADF2 and VOR2 bearings by a double-barred pointer.

E. Remote Magnetic Compensator

The remote magnetic compensator compensates the flux valve output for magnetic variations which may occur around the location of the flux valve due to the aircraft magnetic fields originating from magnetic parts and electrical equipment. The compensator produces d.c. signals in each of the flux valve signal wires. A total of $\pm 10^{\circ}$ of correction can be obtained.

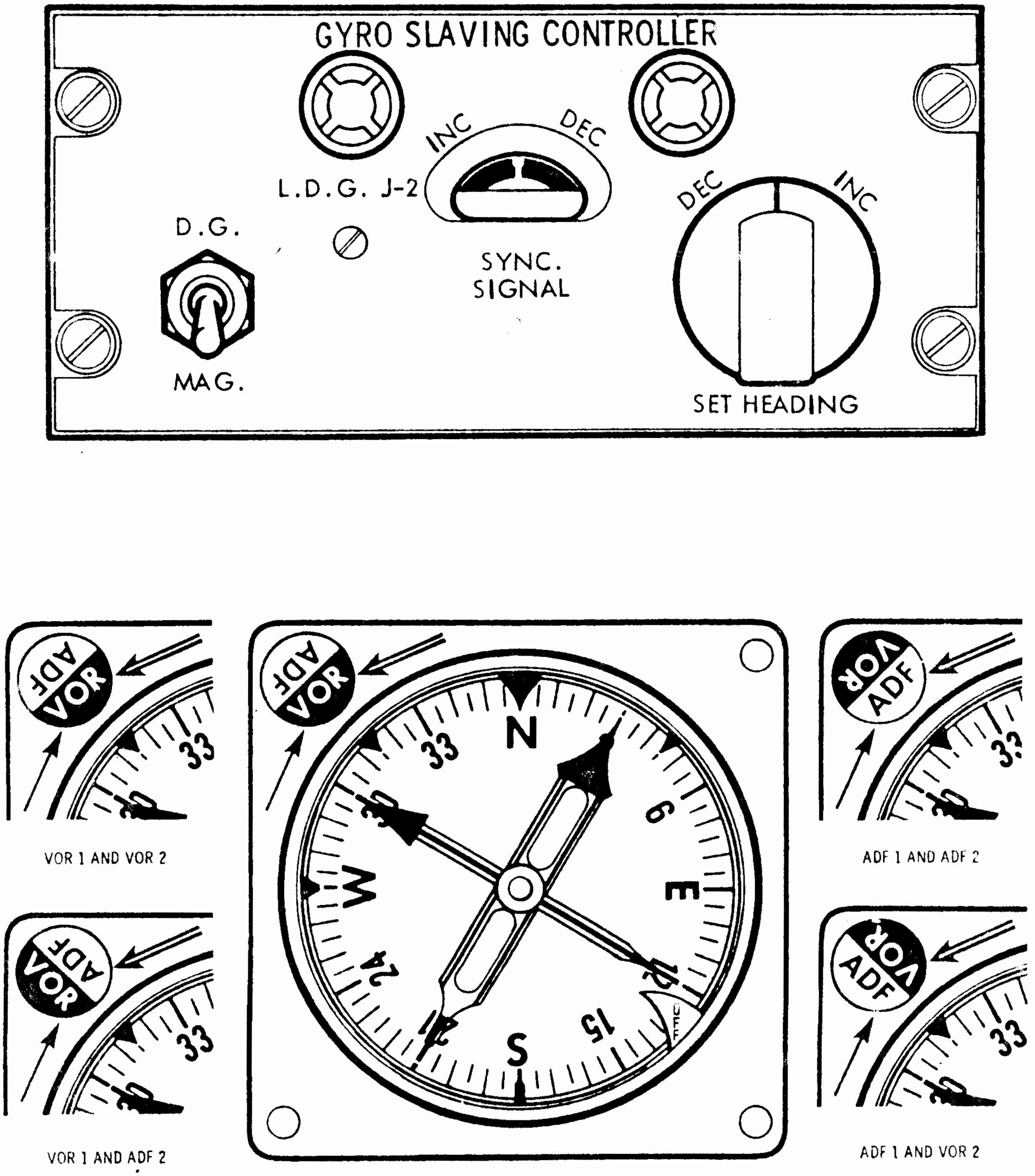
F. Directional Gyro

The directional gyro is controlled in azimuth by the flux valve while its spin axis is maintained in a horizontal plane by means of a liquid leveling switch. The gyro contains two synchros, with rotors linked to the azimuth gimbal and stators attached to the gyro housing. When the aircraft turns, the gyro housing rotates about the gimbal, changing the angle between the synchros stators and rotors. One synchros in each gyro supplies a heading signal to the servo synchro in the corresponding RMI. In the pilots system only, the second synchro supplies a heading signal to the auto-pilot system.

G. System Transfer

In case the pilots system directional gyro fails, the pilot can obtain information from the co-pilots system for his own indicator by selecting CO-PI on the compass system selector switch. This actuates the compass selector switch which disconnects the pilots gyro heading information from the pilots RMI and connects a repeater synchro in the co-pilots RMI to the pilots RMI.

When the pilots RMI is connected this way, the AG-DG switch on the pilots J-2W controller should be set to DG. If the switch remains at MAG, a portion of the servo loop is still active from the flux valve via the flux valve synchro (RMI) and A-2 amplifier to the slaving motor in the gyro. The servo synchro (RMI), however, determining RMI rotor position, receives its signal from the co-pilots system. As long as the rotor position fails to coincide with the flux valve synchro null, the gyro slaving motor is driven. Consequently, when normal operation is resumed, the gyro may be



J-[illegible] Controller and Radio Magnetic Indicator
Figure [illegible]

G. System Transfer (Continued)

found at some random heading remote from the heading required. This is avoided by switching to DG so that the gyro maintains heading by its own rigidity during transfer operation and will be close to the correct heading when normal operation is resumed.

Integrated Director System (IDS)

The integrated director system (IDS) provides a constant display of all information needed for ILS approaches and enroute navigation (Ref. Fig 11). Two identical integrated director systems are installed, one for the pilot and one for the co-pilot. The systems derive magnetic heading data from the magnetic compass system and radio navigational signals from the VOR/ILS systems.

The IDS provides the pilot with the following information:

(1) Roll and bank attitude with respect to a fixed reference (horizon).

(2) Pitch attitude with respect to a selected pitch reference.

(3) Magnetic heading of the aircraft.

(4) Selected magnetic heading error.

(5) Computed steering command.

(6) VOR bearings.

(7) Aircraft position relative to selected VOR radial.

(8) Aircraft position relative to glide slope.

(9) To-from indication relative to omni-range stations.

(10) Visual warning of unreliable information.

A. Operation

The ILS-HDG control knob on the approach horizon selects the ILS and HEADING mode of operation and actuates microswitches and relays for selection of the appropriate circuits.

(1) Heading Mode

The steering computer is fed with two signals, these being a bank signal from a bank synchro transmitter in the approach horizon and

A. Operation (Continued)

(1) Heading Mode (Continued)

an error signal from the selected heading synchro in the course indicator. When the heading marker, which is coupled to the selected heading synchro, does not coincide with the lubber line, indicating the aircraft being off heading, an error signal will appear across the rotor terminals of the synchro. When the aircraft drifts off its heading, a deflection of the steering pointer indicates the direction and amount of bank necessary to bring the aircraft back on its intended heading, which is obtained by banking the aircraft until the steering pointer is centered. Recovery of the selected heading will cause the steering pointer to deflect in the poopsite direction indicating that the amount of bank should be gradually reduced to keep the steering pointer centered. The output of the selected heading synchro is also fed to the auto pilot system.

When the course arrow on the course indicator indicates a VOR radial other than through the aircraft position and a VOR signal is received, a signal from the instrumentation unit will deflect the course bar and the TO-FROM indicator on the course indicator. The course bar deflection signal is generated by means of the course selector resolver, comparing VOR information with the bearing selected by the course arrow. The TO-FROM indicator shows the direction in which the aircraft is flying with respect to the VOR ground station. The course bar deviation will decrease when the aircraft is approaching the point of interception of the selected VOR radial. Course bar deviation signal is also fed to the auto pilot system.

(2) ILS Mode

When it is desired to fly along a localizer course, ILS mode is selected on the approach horizon. The course arrow is set to the localizer course by means of the course control knob on the course indicator.

(3) Pitch and Bank Indication

Pitch and bank signals originate in the vertical gyro. When the pitch attitude of the aircraft changes, an error signal from the pitch synchro is applied to the pitch servo amplifier in the instrument amplifier, amplified, and used to drive the pitch servo motor in the approach horizon. The servo motor in turn drives the synchro rotor until it reaches a null position, when the pitch bar will indicate the pitch attitude of the aircraft.

The bank signal is applied to the bank synchro control transformer in the approach horizon. Any variation in bank attitude of the

Intentionally Left Blank

(3) Pitch and Bank Indication (Continued)

aircraft will create an error signal which is amplified in the instrument amplifier and used to drive the horizon disc and synchro rotor by means of a servo motor in a manner similar to that for the pitch bar. In the ILS mode, the output of the bank phase detector is combined with the course datum signal and a portion of the localizer signal. This provides automatic crosswind correction.

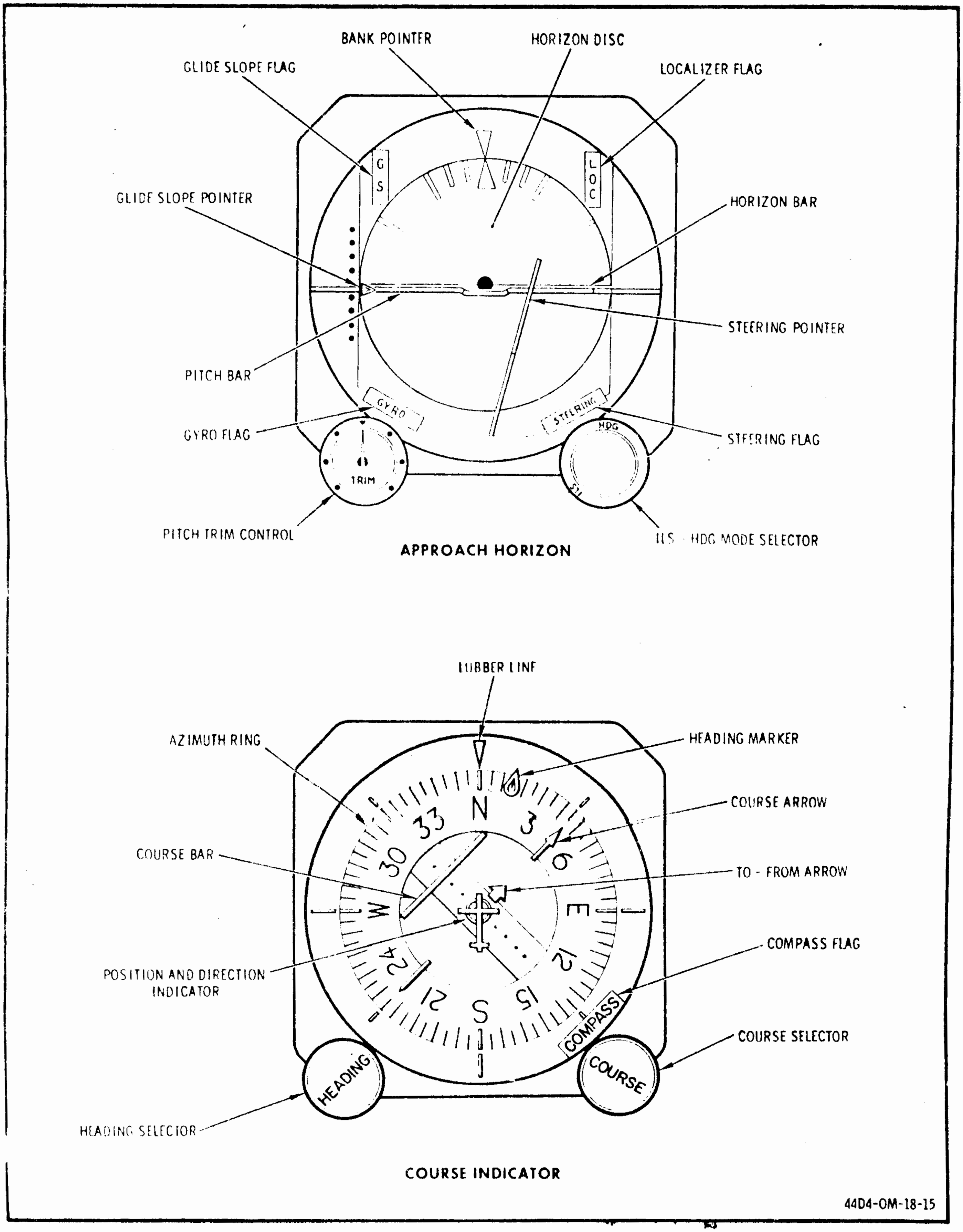
B. Components and Locations

The components and their locations are as follows:

Component	Location
Approach Horizon (2)	Pilots and Co-pilots Instrument Panel
Course Indicator (2)	Pilots and Co-Pilots Instrument Panel
Instrument Amplifier (2)	Forward Hold
Steering Computer (2)	Forward Hold
VOR2 Selector Switch	Pilots Overhead Panel
Vertical Gyro (2)	Forward Hold
Gyro Selector (Rotary Solenoid)	Forward Hold
IDS Selector (Rotary Solenoid)	Forward Hold
Pilots Vertical Gyro Selector Switch	Pilots Instrument Panel

C. Course Indicator

The course indicator is a 4-inch panel-mounted instrument which combines magnetic heading and radio position information to provide a pictorial display of the aircraft position (Ref. Fig 12). The azimuth ring displays magnetic heading in graduations of 5^{o} and is read against the lubber line at the top of the instrument. The heading marker displays the selected heading on the azimuth ring scale and the deviation from the selected heading with respect to the lubber line. The course arrow indicates the



Approach Horizon and Course Indicator
Figure 12

C. Course Indicator (Continued)

selected VOR radial or localizer course, and the course bar simulates the position of this radial or course with respect to the aircraft position. The course bar is the middle section of the course arrow. Deviation from selected course is measured by lateral displacement of the course bar from the course arrow, against a dotted scale in which each division represents 2°. When the system is operating in HDG mode, the to-from arrow points in the direction of the VOR station along the selected radial. The to-from arrow is not displayed in ILS operation. A stationary miniature airplane, centered on the instrument face, is headed towards the course bar when the aircraft is approaching the selected course. The control knob marked HEADING provides selection of magnetic heading by means of the heading marker, while the knob marked COURSE is used to select a VOR radial or localizer course. The instrument is integrally lighted from the aircraft lighting system from a 5-volt a.c. power source. The compass flag, in the lower right corner of the instrument face, becomes visible when heading channel power to the instrument amplifier is interrupted, when there is not output from the heading transmitter in the RMI, or when the compass repeater synchro error in the course indicator exceeds 4.5°.

D. Approach Horizon

The approach horizon is a 4-inch panel-mounted instrument that combines attitude and steering information to present a pictorial display of the aircraft attitude and of its position with relation to the glide slope and approach bearing. A switch at the lower right corner of the instrument is used to switch the IDS from heading to ILS mode of operation (Ref. Fig 12).

The horizon disc presents the bank attitude of the aircraft with the horizon as a reference. A bank scale at the top of the instrument face indicates the amount of bank by means of a pointer. The disc has a free movement of 360° and is driven by the bank servo motor.

The pitch bar, shaped to symbolize the forward looking aspect of the aircraft, indicates pitch attitude. Nose-up conditions are indicated by a pitch bar deflection above the horizon line and nose-down conditions by a deflection below the horizon line. The pitch bar is driven by the pitch servo motor.

The pitch trim control permits manual selection of a pitch reference other than horizontal, in HDG mode, to maintain level flight. In ILS mode, the pitch bar is driven to a position, preset in the instrument amplifier during bench test, which indicates the pitch attitude necessary to remain on the glide slope. When the pitch attitude is correct, the pitch bar centers on the vertical glide slope scale. The glide slope pointer, a

D. Approach Horizon (Continued)

short arrow at the left of the instrument, receives signals from the glide slope receiver during an ILS approach. It indicates the position of the aircraft with respect to the glide slope. A deflection above the horizontal center-line indicates that the aircraft is below the glide slope. The pointer is also read against the pitch bar to indicate the pitch correction. If the pitch bar is above the glide slope pointer, a nose down correction is necessary.

The steering pointer is fed from the steering computer and operates in two different modes: HDG and ILS. A deflection to the left or right from the zero position is a command to bank the aircraft to the left or right in order to approach the selected heading.

The rectangular flag indicators disappear when reliable operation of the circuit is obtained.

E. Vertical Gyro

The vertical gyro senses the changes in aircraft attitude, and converts these changes into voltages proportional to the degree of pitch and bank. The pitch and bank signals are fed to control transformers in the approach horizon to actuate the pitch bar and horizon disc respectively. The bank signal is also fed to the bank phase detector in the steering computer, the output of which is mixed with the bank command signal, amplified, and used to drive the steering pointer.

F. VOR2 Selector Switch

The VOR2 selector switch has three positions: NORMAL, COMM and EMERG. When set to EMERG, the switch transfers the VOR2 instrumentation unit outputs from the co-pilots IDS to the pilots IDS. The VOR1 instrumentation unit is thereby isolated from the IDS.

G. Pilots Vertical Gyro Selector Switch

The pilots vertical gyro selector switch provides selection of attitude information from either the pilots vertical gyro or the bootstrap synchro transmitters in the co-pilots approach horizon. This enables the pilot to obtain attitude information on the IDS instruments in case of failure of the pilots vertical gyro. The bootstrap transmitters repeat the information from the co-pilots vertical gyro.

G. Pilots Vertical Gyro Selector Switch (Continued)

NOTE (CONTINUED):

information is transferred to the pilots approach horizon but bank information is not transferred to the pilots steering pointer. Steering pointer information is still being supplied by the pilots steering computer and since this information may be inaccurate, it should not be relied on.

H. Steering Computer

(1) The steering computer supplies a bank command signal to the steering pointer of the approach horizon. It will function in one of two modes, HDG or ILS, selected by a control knob at the approach horizon. In the HDG mode the steering computer receives two signals:

a. Selected heading error signal from the selected heading synchro in the course indicator which provides signals proportional to the amount and direction of deviation between the selected and actual heading.

b. A bank signal from the vertical gyro which is proportional to the amount and direction of bank.

(2) In the ILS mode, the steering computer receives three signals:

a. A localizer deviation signal from the VOR/ILS system proportional to the amount and direction of deviation from the localizer bearing.

b. A course datum signal from the course datum selector synchro in the course indicator which is proportional to the difference between the selected localizer course and the actual heading.

c. A bank signal similar to that used in the HDG mode.

These signals are mixed, ampliied and fed to the steering pointer amplifier which actuates the steering pointer in the approach horizon. The computer includes a flag warning circuit which displays a flag warning signal on the face of the approach horizon when the steering computer is not operating. The computer power is derived from the aircraft 115-volt a.c. system via the IDS circuit-breakers.

I. Power

Power for the IDS is derived from the aircraft 115-volt 400-cycle a.c.

I. Power (Continued)

system via three circuit-breakers for each of the two systems. No. 2 IDS has an additional circuit-breaker for the excitation for No. 2 vertical gyro. The system is switched into operation when the circuit-breakers are pushed in. A two-position toggle switch at the pilots instrument panel provides the pilots IDS with attitude information from either No. 1 vertical gyro or the bootstrap transmitters in the co-pilots approach horizon.

Periscopic Sextant

The periscopic sectant is an optical device by which position information may be obtained. It is supported by a mount which is attached to the roof of the aircraft fuselage adjacent to the navigators station. Lighting for the sextant is powered from the aircraft d.c. system.

Flight Data Recorder

The flight data recorder provides a record, on metal foil, of altitude, airspeed, heading and vertical acceleration. The system consists of a recorder containing a magazine assembly and a remotely situated accelerometer. The recorder assembly is located on the systems operators equipment rack and the accelerometer on the front spar. Power is supplied to the system from the 115-volt 400-cycle a.c. bus B through a 5-ampere circuit-breaker on the MDP, an ON/OFF switch on the pilots overhead panel, and 26-volt a.c. from an instrument transformer in the compass system through a ½-ampere fuse on the MDP. In the event of a power failure in the system, the fault is indicated by amber lights marked FLT REC FAIL on the pilots and co-pilots annunciator panels and by flashing amber master caution lights on the instrument panel shroud.

Power Sources

The power sources and circuit-breakers for the gyro magnetic compass and the IDS system are as follows:

	Quantity
(1) Constant-frequency A.C. - Bus A	
No. 1 Compass System - Gyrosyn	3
No. 1 Compass System - Remote Magnetic Compensator	1
No. 1 Compass System - Pilots RMI	1
No. 1 Compass System - Pilots RMI Servo Amp	1
No. 1 Compass Amplifier	1

Power Source (Continued)

	Quantity
No. 1 Integrated Director System - No. 1 VG and Attitude Channel	1
No. 1 Integrated Director System - Heading Channel	1
No. 1 Integrated Director System - Steering Computer	1
No. 2 Compass System - Gyrosyn	3
No. 2 Compass System - Remote Magnetic Compensator	1
No. 2 Compass System - Co-pilots RMI	1
No. 2 Compass System - Co-pilots RMI Servo Amp	1
No. 2 Compass System - Navigator RMI	1
No. 2 Compass System - Navigator RMI Servo Amp	1
No. 2 Integrated Director System - Attitude Channel	1
No. 2 Integrated Director System - Heading Channel	1
No. 2 Integrated Director System - Steering Computer	1
No. 2 Integrated Director System - No. 2 Vert. Gyro	1
No. 2 Integrated Director System - Vert. Gyro and attitude channel	1

(2) D.C. Main Bus

No. 2 Compass Amplifier	1

(3) D.C. Essential Bus - Panel A

OMEGA NAVIGATION SYSTEM - SYSTEM DESCRIPTION

An Omega navigation system provides worldwide radio aid to navigation. Eight Omega broadcast stations provide the ground radio network. Seven Navy VLF communication stations provide a backup for the Omega stations. The airborne equipment consists of a control display unit (CDU), A receiver processor unit (RPU) and an antenna coupler unit (ACU). A course deviation indicator (CDI) is installed, and an autopilot ONS switch couples the autopilot to the system.

Omega Stations

Letter	No.	Location	Latitude	Longitude
A	1	Aldra, Norway	66°25'N	13°08'E
B	2	Monrovia, Liberia	6°18'N	10°40'W
C	3	Haiku, Hawaii, USA	21°24'N	157°50'W
D	4	La Moure, North Dakota, USA	46°22'N	98°20'W
E	5	La Reunion	20°58'S	55°17'E
F	6	Golfo Nuevo, Argentina	43°03'S	65°11'W
G	7	Australia	38°29'S*	146°56'E*
Gt	7	Trinidad (temporary)	10°42'N	61°38'W
H	8	Tsushima, Japan	34°37'N	129°27'E

*Trinidad will operate as station G until Australia begins transmitting.

Each station transmits three basic frequencies: 10.2 kHz, 11.33kHz, and 13.6 kHz. To prevent signal interference between stations, transmissions are timed such that only one station is transmitting a particular frequency at a time.

VLF Communication Stations

No.	Location	Latitude	Longitude	Frequency (kHz)	Pwr (KW)
1	Maine	44°39'N	67°17'W	17.8	1026
2	Japan	34°58'N	137°01'E	17.4	48
3	Washington	48°12'N	121°55'W	18.6	124
4	Hawaii	21°26'N	158°09'W	23.4	588
5	Maryland	38°60'N	76°27'W	21.4	588
6	Australia	21°49'S	114°10'E	22.3	989
7	Great Britian	52°22'N	001°11'W	16.0	40

Each station transmits a specific frequency.

Navigation Modes

The ONS operates in four navigation modes. The first two are considered primary, and the second two are considered secondary. The modes are as follows:

-Hyperbolic with three or more Omega stations.
-Ranging with three or more Omega/VLF stations.
-Ranging with two stations.
-Dead reckoning.

In hyperbolic navigation, the ONS uses signals from Omega stations only. A minimum of three stations is required to fix position. The ONS operates in hyperbolic navigation mode whenever possible.

In ranging mode, the ONS uses signals from any combination of Omega and/or VLF stations. One station provides one line-of-position (LOP); hence a minimum of two stations is required to fix position. If three or more stations are in use, the ONS is operating in primary mode; if only two stations are in use, the ONS is operating in secondary mode.

The ONS automatically shifts to dead reckoning mode, and the D and R lights come on when one of the following occurs: fewer than two stations are available, power is restored after interruption, or position is updated. The ONS navigates accurately in DR, and autopilot operation is not affected.

Lane Counting

Signals from Omega and VLF transmitters are received as changes in signal phase and amplitude (signal strength). Information regarding range or distance is carried in the phase of the received signal. The phase measurement (phase shift) of the received signal, relative to the transmitter reference, is due to the time required for the transmitted signal to reach the receiver. Due to the repetitive nature of the transmitted signal, the Omega system has an inherent ambiguity. That is, the same phase measurement will be obtained at more than one unique geographical position. The distance between these equal phase points is referred to as a lane. In the hyperbolic mode, the lanes are repeated every 16 miles. Entry of present position during the initialization of the system establishes the starting lane. Thereafter, the system can be relied on to count lanes as it navigates to avoid ambiguity.

Lane Resolution

An objective of the ONS is "hands-off" fully automatic operation. With VLF stations in addition to Omega signals, it is extremely unlikely that the system will lose lane count and revert to DR modes due to loss of signals. Loss of lane count can occur, however, due to power interruptions, receiver malfunctions, propagation disturbances and unusually high noise conditions. When Omega signals are re-acquired, the system automatically compares the last computed DR position to the Omega/VLF station signal position. The AMBG light comes on when DR lane count differs from the lane count based upon Omega signals. Accomplishing the LANE RESOLUTION procedure lets the system shift to the new position.

Exact Navigation

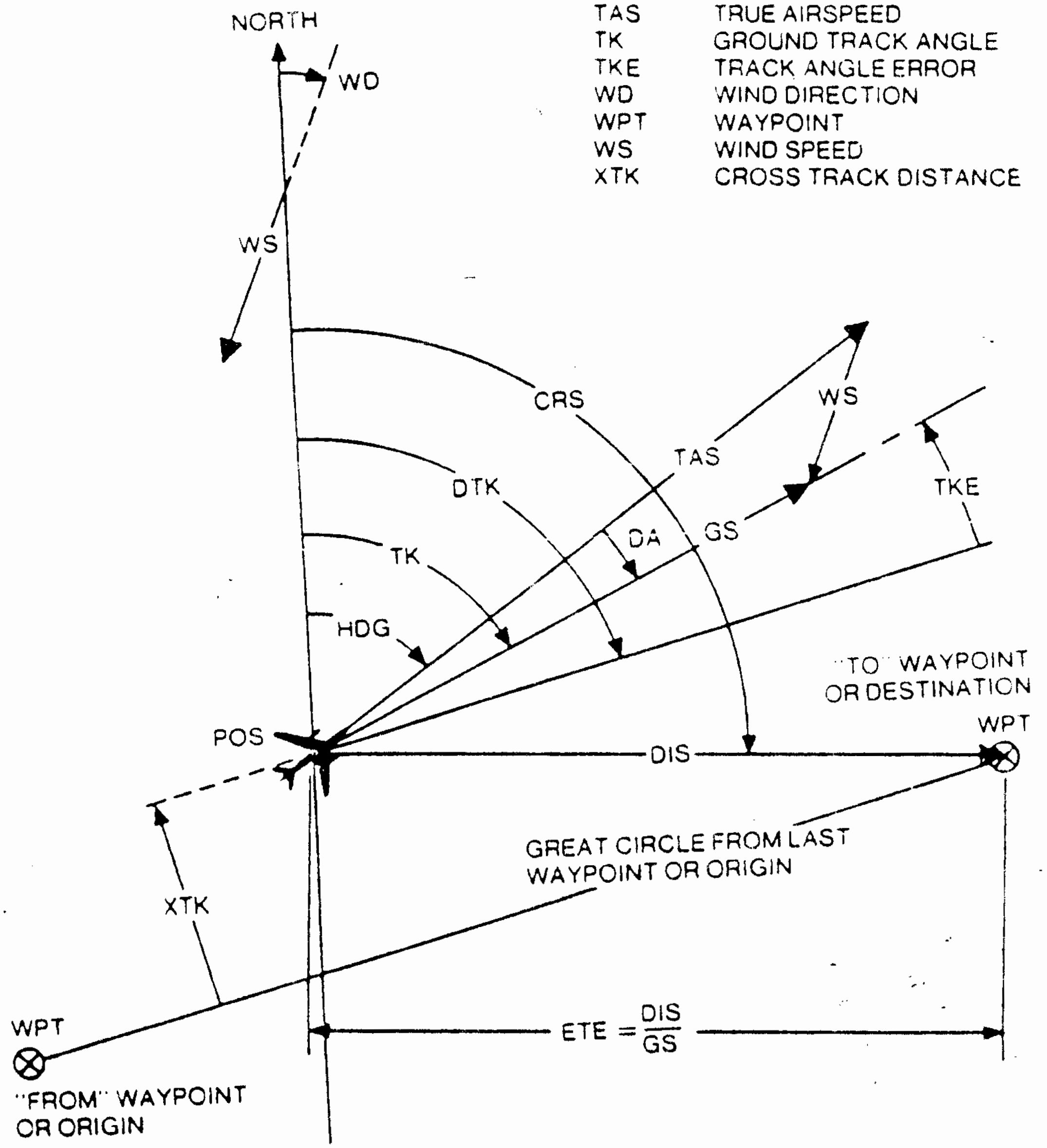
Exact navigation is a feature that enables the ONS to compute and display present position within 1 1/2 nautical miles of acutal position following a precise position entry or update. It is normally used to insure more accurate navigation over domestic routes, or off airways direct flight in domestic airspace. When the EXACT NAVIGATION procedure is accomplished, the ONS determines phase corrections for Omega and VLF signals and applies these corrections in computations of present position. Exact navigation is a timed mode: it lasts 60 minutes. At the end of 60 minutes or when exact avigation is cancelled, the corrections are bled off to zero within five minutes. The one hour timer can be restarted at any time by accomplishing the EXACT NAVIGATION procedure.

Ramp Protect

When on the ground, the computer is inhibited from using Omega/VLF signals to determine present position. The ONS still receives and processes the Omega/VLF signals but does not use them to update position. While in the ramp area, this feature prevents electrical interference from causing erroneous reporting of present position. The ramp protect function is controlled by the landing gear safety switch and is automatically turned off 12 seconds after lift-off. On arrival, ramp protect automatically turns on about 12 seconds after touchdown and present position at that point is retained. Ramp protect can also be turned off by pushing the HLD (hold) switch. The recommended procedure is to turn off ramp protect with the HLD switch when clear of the gate area (see TAXI OUT procedure).

Navigational Relationships

CRS	NORTH BEARING TO WPT
DA	DRIFT ANGLE
DIS	GREAT CIRCLE DISTANCE FROM POS TO NEXT WPT OR DESTINATION
DTK	DESIRED TRACK ANGLE
ETE	ESTIMATED TIME EN ROUTE
GS	GROUND SPEED
HDG	HEADING
POS	PRESENT POSITION
TAS	TRUE AIRSPEED
TK	GROUND TRACK ANGLE
TKE	TRACK ANGLE ERROR
WD	WIND DIRECTION
WPT	WAYPOINT
WS	WIND SPEED
XTK	CROSS TRACK DISTANCE



NAVIGATION - CONTROLS AND INDICATORS

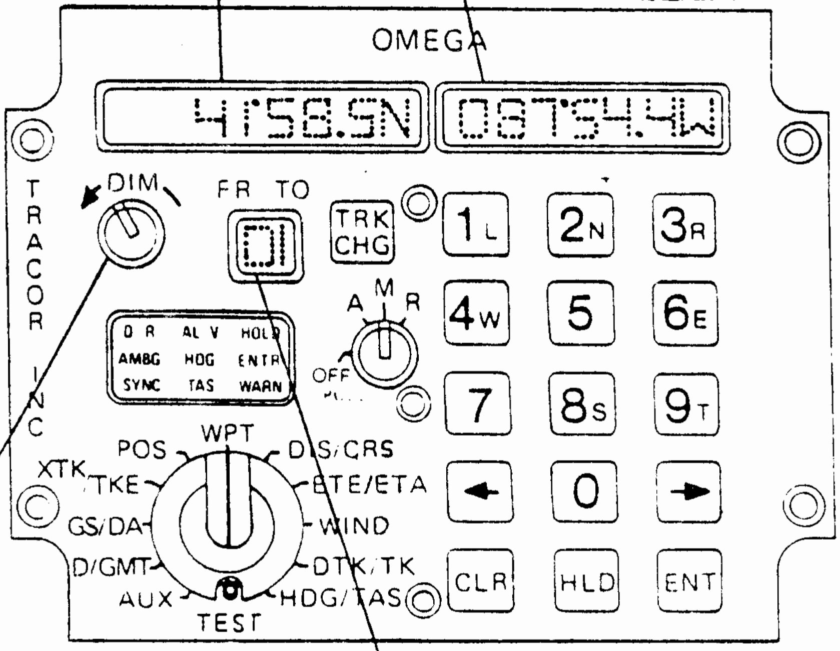
ONS CONTROL DISPLAY UNIT

LEFT DATA DISPLAY

Indicates test and fault code numbers, light test display, Omega stations in use, month and day, ground speed, cross track distance, present latitude, waypoint number and latitude, distance to or between waypoints, estimated time en route, wind direction, head or tail wind, desired track, and heading.

RIGHT DATA DISPLAY

Indicates test and fault codes, program number, light test display, VLF stations in use, Greenwich mean time, drift angle, track angle error, present longitude, waypoint longitude, course, estimated time of arrival, wind speed, track angle, and true airspeed.



DIM KNOB

Dims control display unit lighting. Positions below full on will increase life of display bulbs.

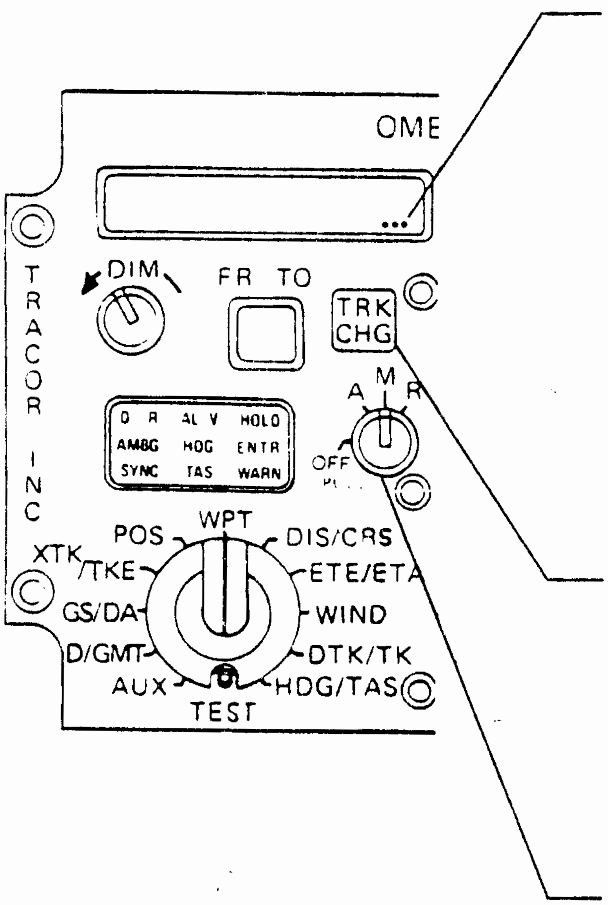
FR-TO DISPLAY

STEADY - Indicates FROM and TO waypoint numbers.

FLASHING - Indicates next waypoint in sequence has not been entered. Goes off when data selector is positioned to WPT and next waypoint coordinates are entered.

Location: Forward Control Pedestal

ONS CONTROL UNIT DISPLAY



CURSOR

Indicates that more numbers or letters are required to complete the entry step. The cursor must be displayed before numbers or letters can be entered. The cursor normally appears in the position where data must be entered. Example: When entering latitude, the cursor appears in the right side of the display because the hemisphere (N or S) is entered first. If cursor is not automatically positioned, CLR switch must be pushed and released to properly position cursor.

TRK CHG SWITCH

Allows manual track change when AMR selector is positioned to A or M.

Allows waypoints to be changed without disturbing normal operation when AMR selector is positioned to R.

AMR SELECTOR

OFF - Turns off ONS and clears all data from memory.

A (Auto) - Allows ONS to navigate to each waypoint in sequence and automatically change to the next navigation leg.

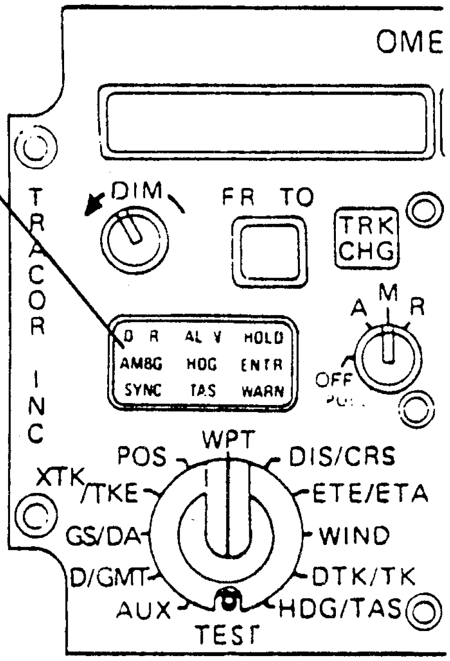
M (Manual) - Allows ONS to navigate up to and past the TO waypoint. Allows track change to next navigation leg to be initiated manually.

R (Remote) - Allows verification of flight plan. Allows display of DIS, CRS, ETE, and ETA for tracks other than the track the airplane is currently flying.

Location: Forward Control Pedestal

ONS CONTROL DISPLAY UNIT

STATUS/WARNING LIGHTS



ALL LIGHTS FLASHING - Indicate data format was invalid. Go off when data is re-entered.

D R - Indicates ONS is in dead reckoning mode.

R - Indicates ONS is in ranging mode using two stations.

AL (alert) -

STEADY - Indicates airplane is within 2 minutes 10 seconds of TO waypoint when AMR selector is positioned to A or M. Goes off when ONS automatically changes to next navigation leg (AMR selector in A) 1 minute 10 seconds before arriving at TO waypoint.

FLASHING - Indicates airplane is within 1 minute 10 seconds of TO waypoint when AMR selector is positioned to M. Goes off when next navigation leg is selected manually.

V - Indicates ONS is using at least one VLF station.

HOLD - Indicates present position display is frozen when in flight. Goes off when HLD switch is pushed. Indicates ramp protect is on (present position display frozen) when on the ground. Goes off when HLD switch is pushed or 12 seconds after lift-off.

AMBG (ambiguity) - Indicates DR lane count differs from lane count based upon Omega/VLF station signals. Comes on only after return to primary navigation from DR mode. Goes off when any of the following procedures is accomplished.

-ACCEPT PRESENT POSITION
-LANE RESOLUTION
-POSITION UPDATE

Location: Forward Control Pedestal

HDG - Indicates heading has been entered manually.

ENTR -

STEADY - Indicates data entry (numbers or letters) is not complete when a cursor is in the data display. Indicates the data entry is complete when there is no cursor in data display. Goes off when data entry is complete and ENT switch is pushed.

FLASHING - Indicates entry of date, time and present position has not been completed. Stops flashing when missing data is entered.

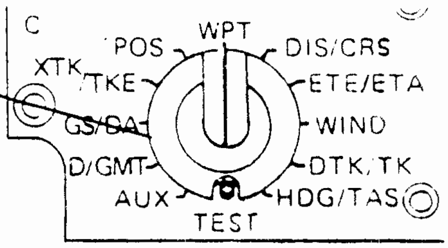
SYNC - Indicates ONS will complete synchronization when ONS locks into Omega network format.

TAS - Indicates ONS is using manually entered true airspeed.

WARN - Indicates system malfunction.

ONS CONTROL DISPLAY UNIT

DATA SELECTOR



The following data display and insert information is provided with the AMR selector positioned to A or M.

TEST - Displays test code 40 and Omega stations in use in left data display; VLF stations in use and the letter U in right data display. See Test Codes in ONS OPERATING GUIDE.

Test light (in index slot) indicates computer is functioning when flashing. Indicates computer is defective when off or on steady.

AUX - Not used.

D/GMT - Displays month and day in left data display; Greenwich mean time in right data display. Allows insertion of month, day and time in associated display.

GS/DA - Displays ground speed in left data display; drift angle (R, L) degrees in right data display. Allows insertion of ground speed and drift angle in associated display only during DR mode.

XTK/TKE - Displays cross track distance (nm) in left data display; track angle error (R, L) degrees in right data display. Allows insertion of cross track distance in left data display.

POS - Displays present position latitude in left data display; present position longitude in right data display. Allows insertion of latitude and longitude in associated display.

WPT - Displays waypoint number and latitude in left data display; waypoint longitude in right data display. Allows insertion of waypoint latitude and longitude in associated data display. Waypoint zero does not change automatically with airplane position. It is redefined with current POS whenever is it is chosen as the FR waypoint, when position is updated or EXACT NAVIGATION procedure is accomplished. Pushing advance switch or backspace switch sequences display to next waypoint.

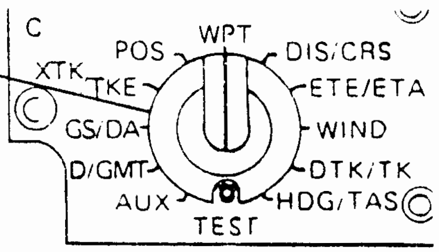
DIS/CRS - Displays distance (nm) between present position and TO waypoint in left data display; magnetic course between present position and TO waypoint in right display. Right display shifts from magnetic to true course when T switch is pushed.

ETE/ETA - Displays estimated time en route to the next waypoint in the left data display; estimated time of arrival (GMT) in right data display. Times are based on current ground speed.

Location: Forward Control Pedestal

ONS CONTROL DISPLAY UNIT

DATA SELECTOR



The following data display and insert information is provided with the AMR selector positioned to A or M.

WIND - Displays wind direction (true) in left data display; wind speed (knots) in right data display. Left data display indicates H (head) or T (tail) and right data display indicates head or tail wind speed when T switch is pushed. Left data display indicates wind direction (magnetic) and right data display indicates wind speed (knots) when T switch is pushed a second time. Allows insertion of wind direction and speed in associated display. The manually inserted wind is automatically updated when operating in primary navigation mode. Wind is not automatically updated when operating in DR navigation mode.

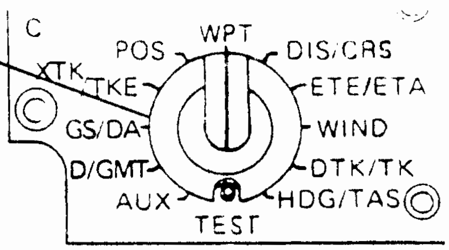
DTK/TK - Displays desired track angle (magnetic) in left data display; current track angle (magnetic) in right data display. Both displays shift from magnetic to true track angle when the T switch is pushed.

HDG/TAS - Displays magnetic heading in left data display; true airspeed in right data display. Left data display shifts from magnetic to true heading when T switch is pushed. Allows insertion of heading and true airspeed in associated display.

Location: Forward Control Pedestal

ONS CONTROL DISPLAY UNIT

DATA SELECTOR



The following data display information is provided when the AMR selector is positioned to R.

TEST - Not used.
AUX - Not used.

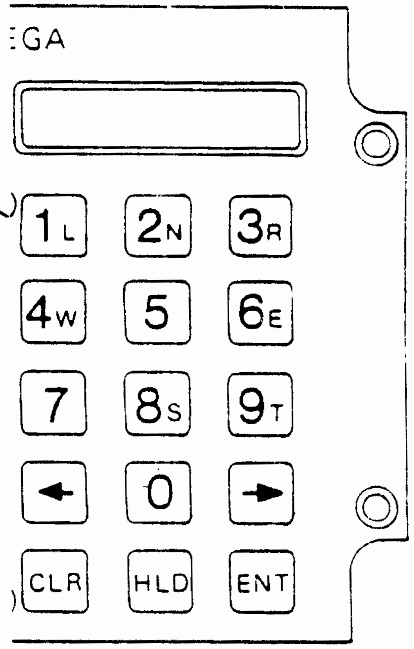
D/GMT
GS/DA
POS
WPT
WIND
HDG/TAS - Provides same data display in these positions as when the AMR selector is positioned to A or M.

XTK/TKE - Blank
DTK/TK - Displays a blank in left data display. Current track angle in the right data display is the same as when the AMR selector is positioned to A or M.

	FR waypoint is not 0 TO waypoint is not 0	FR waypoint is 0 TO waypoint is not 0	FR waypoint is not 0 TO waypoint is 0
DIS -	Great circle distance between FR and TO waypoints	Distance via current flight plan from present position to the TO waypoint.	Great circle distance from present position to the FR waypoint.
CRS -	Average magnetic course from the FR waypoint to the TO waypoint.	Average magnetic course from present position to the TO waypoint.	Average magnetic course from present position to the FR waypoint.
ETE -	Great circle ETE between FR and TO waypoints	ETE via current flight plan from present position to the TO waypoints.	ETE direct from present position to the FR waypoint.
ETA -	Blank	ETA via current flight plan from present position to the TO waypoint.	ETA direct from present position to the FR waypoint.

Location: Forward Control Pedestal

ONS CONTROL DISPLAY UNIT



Display test code numbers, date, time, present position, and waypoint latitude and longitude in data displays, and waypoint numbers in FR-TO display.

Additional letter functions of the number switches:

L - Displays L in left data display and causes ONS, in conjunction with other ONS switches, to accomplish LANE RESOLUTION procedure. Displays L for left drift angle in right data display.

N - Displays N for north latitude in left data display.

R - Displays R for right drift angle in right data display.

W - Displays W for west longitude in right data display.

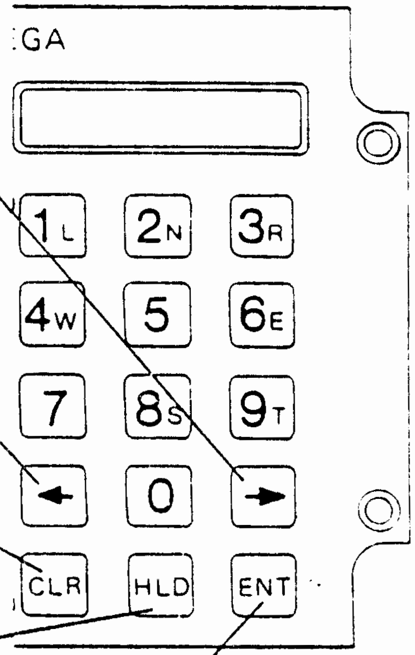
E - Displays E for east longitude in right data display. Causes ONS, in conjunction with other ONS switches, to operate in exact navigation mode.

S - Displays S for south latitude in left data display.

T - Advances test code displays. Changes course, desired track, track angle, and heading displays from magnetic to true. Causes wind display to indicate tail or head wind and changes direction from true to magnetic.

Location: Forward Control Pedestal

ONS CONTROL DISPLAY UNIT



ADVANCE SWITCH

Causes forward sequencing of test code numbers and fault code numbers in the left data display, and waypoint numbers in the FR-TO display.

BACKSPACE SWITCH

Causes reverse sequencing of test code numbers and fault code numbers in the left data display, and waypoint numbers in the FR-TO display.

CLR SWITCH

Causes cursor to appear in data displays. Clears data displays when erroneous data has been entered. Restores HDG and TAS to synchro inputs after manual insertion.

HLD SWITCH

Stops indicated present position from changing. Releases indicated present position in flight, and ramp protect on the ground. In conjunction with other ONS controls, allows accomplishment of following procedures:

-ACCEPT PRESENT POSITION
-LANE RESOLUTION
-POSITION UPDATE
-EXACT NAVIGATION

ENT SWITCH

Controls insertion and removal of data from the RPU (receiver processor unit).

Location: Forward Control Pedestal

OMEGA NAVIGATION SYSTEM OPERATING GUIDE

TURN ON AND TEST

APU OR EXT PWR. . . . . ON

OMEGA-NAV CIRCUIT BREAKERS . . . . SET

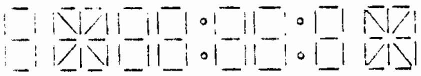
AMR SELECTOR. . . . . . . A OR M
Pull out to turn from OFF.

DATA SELECTOR . . . . TEST

CLR SWITCH. . . . . PUSH
Observe cursor (-) appear in left data display.

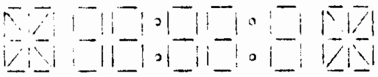
NUMBER SWITCHES 1 & 9 . . . PUSH

ENT SWITCH. . . . . PUSH
Observe:
Left data display indicate as follows:



Right data display indicate program number 800 70 1.

T SWITCH. . . . . PUSH
Observe:
- Left data display indicate 19.
- Right data display indicate as follows:



T SWITCH. . . . . PUSH
Observe:
- Left data display indicate 19.
- Right data display indicate program number 800 70 1.
- FR-TO display indicate 88.
- All status warning lights come on. (D, R, AL, V, HOLD, AMBG, HDG, ENTR, SYNC, TAS, WARN)

LOADING AND INSERTING DATE AND TIME

DATA SELECTOR . . . . . D/GMT

Select month (01-12) and day (01-31) with number switches.

ENT SWITCH . . . . PUSH

Select accurate GMT (hours, minutes, seconds) with number switches. Use ACARS or WWV time if available.

ENT SWITCH . . . . PUSH

LOADING AND INSERTING POSITION

DATA SELECTOR . . . . . . POS

Select N or S, then latitude coordinates with number switches.

Select E or W, then longitude coordinates with number switches.

COORDINATES . . . . . VERIFY
Both crew members verify that coordinates are correct.

ENT SWITCH . . . . PUSH

LOADING AND INSERTING WAYPOINTS

Insert departure ramp position as waypoint 1.

Insert destination ramp position as waypoint 9.

DATA SELECTOR . . . . WPT
The number 1 appears in the left data display.

Select waypoint 1 coordinates (N or S, latitude; E or W longitude).

ENT SWITCH . . . . PUSH

Enter remaining waypoints using the same procedure.

WAYPOINTS . . . . VERIFY

Turn DATA SELECTOR out of and back to WPT.

Verify coordinates of waypoint 1.

ADVANCE SWITCH . . . . . PUSH

Verify coordinates of waypoint 2.

ADVANCE SWITCH . . . . . . PUSH
Sequence through remaining waypoints and verify coordinates.

FLIGHT PLAN . . . . VERIFY

AMR SELECTOR . . . . .R

DATA SELECTOR. . . . . . DIS/CRS
Observe 01 in FR-TO display. If not, push TRK CHG switch, 01 with number switches, then push ENT switch.

FLIGHT LEG 01 . . . . VERIFY
Verify distance as zero.

ADVANCE SWITCH. . . . . . . PUSH
Observe 12 appear in FR-TO display. Verify distance and course from waypoint 1 to waypoint 2.

ADVANCE SWITCH. . . . . . . PUSH
Sequence through remaining flight plan legs and verify distance and course between waypoints.

TAXI OUT

HLD SWITCH . . . . PUSH
When clear of gate area, push HLD switch and observe: HOLD light go off; WARN LIGHT off. The D, R, SYNC and V lights may be on depending on Omega/VLF stations being received.

AMR SWITCH . . . . .A

POSITION CHECK

(To be conducted over a known position, such as overhead a nav facility or at a gateway. ONS position should check within 5 miles of known position.)

DATA SELECTOR . . . . POS

HLD SWITCH . . . . PUSH
Observe HOLD light come on.

Compare POS display to known position.

If position update is not required:

HLD SWITCH . . . . PUSH
Observe HOLD light go off.

If position update is required, follow POSITION UPDATE procedure.

POSITION UPDATE

This procedure is to be used at Captain's discretion considering accuracy of the position check.

If system requires updating, procedure should be performed immediately following position check with DATA SELECTOR in POS and HOLD light on.

AMR SELECTOR . . . . . . A OR M

CLR SWITCH . . . . PUSH

POSITION LATITUDE AND LONGITUDE . . . . LOAD
Normally this position will be a waypoint.

DISTANCE, COURSE, ETE, ETA DETERMINATION

AMR SELECTOR . . . . . . A OR M

DATA SELECTOR. . . . . DIS/CRS OR ETE/ETA

Observe that data displayed is from present postion to the TO waypoint in the FR-TO display at present ground speed.

If it is desired to determine DIS/CRS or ETE/ETA from present position to any other waypoint, or between any two waypoints, proceed as follows:

AMR SELECTOR . . . . R

TRK CHG SWITCH. . . . . . PUSH

Select desired waypoint pair with number switches.

ENT SWITCH. . . . . PUSH

DATA SELECTOR . . . . DIS/CRS OR ETE/ETA

When neither waypoint is zero, the flight plan data is computed great circle from the FR waypoint.

When the FR waypoint is zero, the flight plan data is computed from present position to the TO waypoint along the current flight plan.

When the TO waypoint is zero, the flight plan data is computed from present position great circle to the FR waypoint.

Distance and time displayed between the waypoints in the FR-TO indicator is computed at present ground speed.

To resume normal navigation:

AMR SELECTOR . . . . .A

RESUMING RADIO NAVIGATION

(approaching gateway or preplotted waypoint for resuming radio navigation.)

AMR SELECTOR. . . . . M

When the AL light comes on for the entry gateway waypoint, position AMR selector to M.

When the AL light begins to flash, change the numbers in the FR-TO display, if necessary, to assure that the last en route waypoint and the destination waypoint appear.

OMEGA SHUTDOWN

At destination ramp, verify that the last en route waypoint and the destination waypoint appear in the FR-TO display prior to recording information.

Record in the log book the DIS and XTK before positioning the DATA SELECTOR to OFF.

If DIS or XTK is more than 10 miles, make a discrepancy write-up in the log book "ONS out of tolerance".

If ONS is written up in the log book, indicate if problem occured in flight or on the ground.

AMR SELECTOR . . . . . . OFF

W SWITCH . . . . PUSH

WAYPOINT NUMBER . . . . SELECT
Select number with number switches.

ENT SWITCH. . . . . PUSH

If position is not a waypoint, select coordinates of known position with number switches.

ENT SWITCH. . . . . PUSH

WAYPOINT CHANGE

AMR SELECTOR. . . . . . . A OR M

TRK CHG SWITCH. . . . . . . PUSH

NEW FLIGHT LEG. . . . . . . LOAD
Push number switches in the order the waypoints are to be displayed.

FR-TO DISPLAY. . . . . . . VERIFY
Observe the display reads correct flight leg.

ENT SWITCH . . . . PUSH

ONS - AUTOPILOT OPERATION

AUTOPILOT HDG SEL SWITCH
. . . . ON

AMR SELECTOR . . . . A

FR-TO DISPLAY. . . . . . . VERIFY
Observe that number and sequence of waypoints are correct.

AUTOPILOT ONS SWITCH. . . . OMEGA

COURSE CHANGE

To proceed from present position via a different course, use WAYPOINT CHANGE procedure, setting 0 in the FR and the desired waypoint number in the TO position of the FR-TO display.

After making a course change from present position, the coordinates of the point at which the course change was accomplished will be displayed when the DATA SELECTOR is positioned to WPT and the 0 number switch is pushed.

DEAD RECKONING NAVIGATION

The ONS automatically shifts to dead reckoning mode, and the D R lights come on when one of the following occurs: fewer than two stations are available, power is restored after interruption, or position is updated. If HDG or TAS Light is on, ensure that heading and TAS are accurate. To obtain best accuracy, update wind directly, or indirectly by updating ground speed/drift angle.

To enter heading:

DATA SELECTOR . . . . HDG/TAS

CLR SWITCH . . . . . . PUSH TWICE

Select heading (three numbers) with number switches.

ENT SWITCH. . . . . PUSH

To restore heading to synchro inputs, push CLR switch twice and then push ENT switch.

To enter TAS:

DATA SELECTOR . . . . HDG/TAS

CLR SWITCH . . . . PUSH

Select true airspeed (three numbers) with number switches.

ENT SWITCH. . . . . PUSH

To restore true airspeed to synchro inputs, push CLR switch and then push ENT switch.

To update wind:

DATA SELECTOR . . . . WIND

CLR SWITCH. . . . . PUSH

Select true wind direction (three numbers and wind speed (three numbers) with number switches.

ENT SWITCH . . . . PUSH

To update ground speed/drift angle:

DATA SELECTOR . . . . . . GS/DA

CLR SWITCH . . . . PUSH

Select ground speed (three numbers) with number switches.

Push L (left) or R (right) switch for direction of drift.

Select drift angle (three numbers) with number switches.

ENT SWITCH . . . . PUSH

AMBG LIGHT ON

The AMBG light comes on when DR lane count differs from lane count based upon Omega signals; this can occur only after ONS goes from primary mode to DR mode and then returns to primary mode. Accomplishing any of the following procedures resolves the ambiguity and causes the AMBG light to go off.

-ACCEPT PRESENT POSITION
-LANE RESOLUTION
-POSITION UPDATE

ACCEPT PRESENT POSITION

DATA SELECTOR . . . . POS

HLD SWITCH . . . . PUSH

CLR SWITCH . . . . PUSH TWICE

ENT SWITCH . . . . PUSH

ONS accepts display position as exact. AMBG light goes off.

This procedure cancels lane resolution or exact navigation if previously requested.

LANE RESOLUTION

This procedure can be accomplished only if ONS is using three, three-frequency Omega stations. The procedure is normally accomplished after the AMBG light comes on, however, it can be accomplished without an ambiguity.

DATA SELECTOR . . . . POS

HLD SWITCH . . . . PUSH

CLR SWITCH . . . . . PUSH TWICE

L SWITCH. . . . . PUSH

ENT SWITCH . . . . PUSH

AMBG light goes off (if on). L appears and remains in left side of left data display until lane resolution is completed or cancelled.

This procedure cancels exact navigation if previously requested.

To cancel lane resolution, accomplish ACCEPT PRESENT POSITION procedure.

EXACT NAVIGATION

DATA SELECTOR . . . . POS

HLD SWITCH. . . . . PUSH

CLR SWITCH . . . . . PUSH TWICE

Select latitude and longitude of actual position with number switches.

ENT SWITCH. . . . . PUSH

To cancel exact navigation, accomplish any of the following procedures:
- -ACCEPT PRESENT POSITION
- -LANE RESOLUTION
- -POSITION UPDATE

OFFSET TRACK

DATA SELECTOR . . . . XTK/TKE

CLR SWITCH . . . . PUSH

DESIRED OFFSET . . . . . . ENTER
Push L (left) or R (right) switch for desired offset. Select miles (three numbers) and tenths of a mile (one number) with number switches.

Requested XTK (cross track distance) appears momentarily in left data display, then the offset from the track defined by FR-TO appears. The symbol F is displayed as a reminder that the airplane is flying an offset track.

If ONS is connected to autopilot, the airplane automatically flies to the new track with a maximum intercept angle of 45°.

To revert to normal track:

DATA SELECTOR . . . . XTK/TKE

CLR SWITCH . . . . PUSH

ENT SWITCH . . . . PUSH

If ONS is connected to autopilot, the airplane will automatically intercept and fly the original desired track.

OMEGA/VLF STATIONS AND SIGNALS, AND TEST CODES

CODE	STATION
40	Stations in use.
40(T)	Stations available
41	A 1 Norway
42	B 2 Liberia
43	C 3 Hawaii
44	D 4 North Dakota
45	E 5 La Reunion
46	F 6 Argentina
47	G 7 Trinidad or Australia
48	H 8 Japan
49	Stations deselected.

CODE	STATION
51	1 Maine
52	2 Japan
53	3 Washington
54	4 Hawaii
55	5 Maryland
56	6 Australia
57	7 Great Britian

SLECTION OF STATIONS OR TEST CODES

DATA SELECTOR . . . . TEST

AMR SELECTOR. . . . . . . A OR M

Test code 40 (summary of stations in use and available) is automatically displayed unless the WARN light is on, in which case the fault code 00 appears in the left data display. See WARN LIGHT ON Irregular procedure.

Pushing the advance and backspace switches sequences the code from code 40 through code 57 and back.

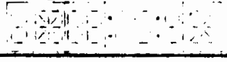
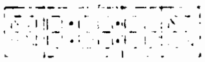
To observe individual stations or test codes:

CLR SWITCH. . . . . PUSH
Push and release CLR switch until cursor appears in left side of left data display.

Select desired test code number with number switches.

ENT SWITCH. . . . . PUSH

TEST CODE TABLE

Test Code	Left Data Display Contents/Format	Right Data Display Contents/Format	Remarks
00	00 XX	ACR A - Antenna C - CDU R - RPU	Displays BITE (Built In Test Equipment) fault code. See WARN LIGHT ON Irregular procedure for fault code.
19	Light test 	Program number 800 70 1	
19(T)	19	Light test 	Pushing T switch causes light test of right data display.
19(T,T)	19	Program number 800 70 1 .	Pushing T switch a second time tests FR-TO display lights and status/warning lights.
40	Test code 40 and Omega stations in use. 40 1 2 3	VLF Stations in use and letter U 1 2 3 U	The advance and backspace switches sequence the code from code 40 through code 57 and back.
40(T)	Omega stations strong enough be available. 1 2 3	VLF stations strong enough to be available and letter A 1 2 3 A	The T switch will cycle displays between stations in use and stations available.
41-48	4X C SEL or or FF OFF	9 9 9 ON OFF or CODE	Status of each Omega station.

Definition of symbols in left data display:

4X	Station for which information is being displayed, i.e., 46 is Argentina.
C	Indicates ONS is using 10.2 kHz signal and 13.6 kHz signal of displayed station.
FF	If station is operating single frequency, the FF equals 10, 11 or 13 to indicate frequency in use. (10.2, 11.33, 13.6 kHz). If station is not in use, neither C nor FF will be displayed.
SEL	Indicates the station has not been deselected.
OFF	Indicates the station has been deselected (reason is indicated in right data display).

(Continued)

TEST CODE TABLE (Continued)

<table>
<tr><th>Test Code</th><th>Left Data Display Contents/Format</th><th>Right Data Display Contents/Format</th><th>Remarks</th></tr>
<tr><td></td><td colspan="3">Definition of symbols in right data display:
9 First digit is signal quality for 10.2 kHz signal. If blank, a VLF station is being tracked in this time slot.
9 Second digit is signal quality for 13.6 kHz signal.
9 Third digit is signal quality for 11.33 kHz signal.
Each signal quality ranges from 0 to 9 (maximum). When signal quality for a frequency becomes 2 or greater, that frequency is available for navigation. If that signal quality thereafter falls to 1 the frequency is no longer usable for navigation. Lane resolution requires three, 3-frequency Omega stations with signal quality 3 3 3 or better.
ON Indicates the station is in use.
OFF Indicates the station is not in use.
CODE Indicates the reason for deselection by letter as follows:
G - Geometry
R - Range
V - VLF test
M - Map (modal interference)
S - Signal instability (modal interference)
T - Omega BITE test
If a station is deselected for more than one reason, pushing the T switch will cause each code to be displayed.</td></tr>
<tr><td>49</td><td>49 and Omega stations deselected
49 1 2</td><td>VLF stations deselected
1 2</td><td>The test stations, BITE and VLF are never displayed.</td></tr>
<tr><td>50</td><td>Blank</td><td>Blank</td><td>Reserved for future use.</td></tr>
<tr><td>51-57</td><td>5X M SEL
or
OFF</td><td>A 9 ON
OFF
or
CODE</td><td>Status of each VLF station.</td></tr>
<tr><td></td><td colspan="3">Definition of symbols in left data display:
5X VLF station for which information is being displayed.
M Single digit code (0, 1, 2, 3, 4) which indicates modulation type for the station. Used by maintenance.
SEL Indicates the station has not been deselected.
OFF Indicates the station has been deselected (reason is indicated in right data display).</td></tr>
</table>

(Continued)

TEST CODE TABLE (Continued)

<table>
<tr><th>Test Code</th><th>Left Data Display Contents/Format</th><th>Right Data Display Contents/Format</th><th>Remarks</th></tr>
<tr><td></td><td colspan="3">Definition of symbols in right data display:
A Single letter code (A through H) indicating the Omega station whose 10.2 kHz time slot is being used to track the VLF Signal. If no letter is displayed, the VLF station's signal is not being tracked.
9 Single digit representing signal quality for the VLF signal. No signal quality is displayed if the VLF signal is not being tracked. Each signal quality ranges from 0 to 9 (maximum). When signal quality for a frequency becomes 2 or greater, that frequency is available for navigation. If that signal quality thereafter falls to 9, the frequency is no longer available for navigation.
ON Indicates the station is in use.
OFF Indicates the station is not in use.
CODE Indicates the reason for deselection by letter as follows:
G - Geometry V - VLF test
R - Range M - Map (modal interference)
T - Omega BITE test
If a station is deselected for more than one reason, pushing the T switch will cause each code to be displayed.</td></tr>
<tr><td>70</td><td>Not used by UA.</td><td></td><td></td></tr>
<tr><td>70(T)</td><td>Not used by UA.</td><td></td><td></td></tr>
<tr><td>71</td><td>71XX°XX.XN(S)
Latitude</td><td>XXX°XX.XE(W)
Longitude</td><td>For power loss greater than 7 seconds, displays latitude/longitude at time of power loss.</td></tr>
<tr><td>72</td><td>72</td><td>XX: XX:XX:
GMT HR:MIN:SEC</td><td>For power loss greater than 7 seconds, displays GMT of power loss.</td></tr>
<tr><td>73</td><td>73XXX°M(T)
Heading</td><td>XXX K
True airspeed</td><td>For power loss greater than 7 seconds, displays last value of HDG/TAS.</td></tr>
<tr><td></td><td colspan="3">If HDG or TAS have changed substantially during extended power outage, their new values should be entered in test code 73 before updating time, so that DR to make up for power outage will represent the actual flight conditions.</td></tr>
<tr><td>74-79</td><td colspan="3">Not used by UA.</td></tr>
</table>

AUTOMATIC STATION DESELECT

The ONS may deselect a station, and remove it from navigational use for range, geometry, modal interference, and test. The ONS deselects VLF and single frequency Omega stations when present position lies within the station's region of modal interference and night is in the shortest path from present position to that station. The ONS deselects three-frequency Omega stations when the ONS detects presence of modal interference. The ONS deselects two of the Omega stations for test. One station is deselected for VLF test and the other for Omega BITE test. Reasons for deselection are indicated in the Test Codes.

AUTOMATIC STATION RESELECT

The ONS reselects a station when the reasons for deselection are no longer present.

ONS WARN LIGHT ON

DATA SELECTOR. . . . . TEST

TEST LIGHT (in index slot of TEST position) . . . . OBSERVE
Light flashing indicates computer is functioning.
Light off or on steady indicates defective computer.

LEFT DATA DISPLAY . . . . OBSERVE
00 followed by a number from 01 to 16 or number/letter 01X to 15X. The letter X indicates multiple malfunctions. If X follows the number, push, the advance switch to locate the multiple malfunctions.(See malfunction code table below.)

RIGHT DATA DISPLAY . . . . OBSERVE
The letters A, R and/or C may appear to indicate a defective antenna coupler unit, receiver processor unit or control display unit.

MALFUNCTION WRITE-UP IN LOG BOOK . . . . COMPLETE
Include test light action and/or malfunction code number.

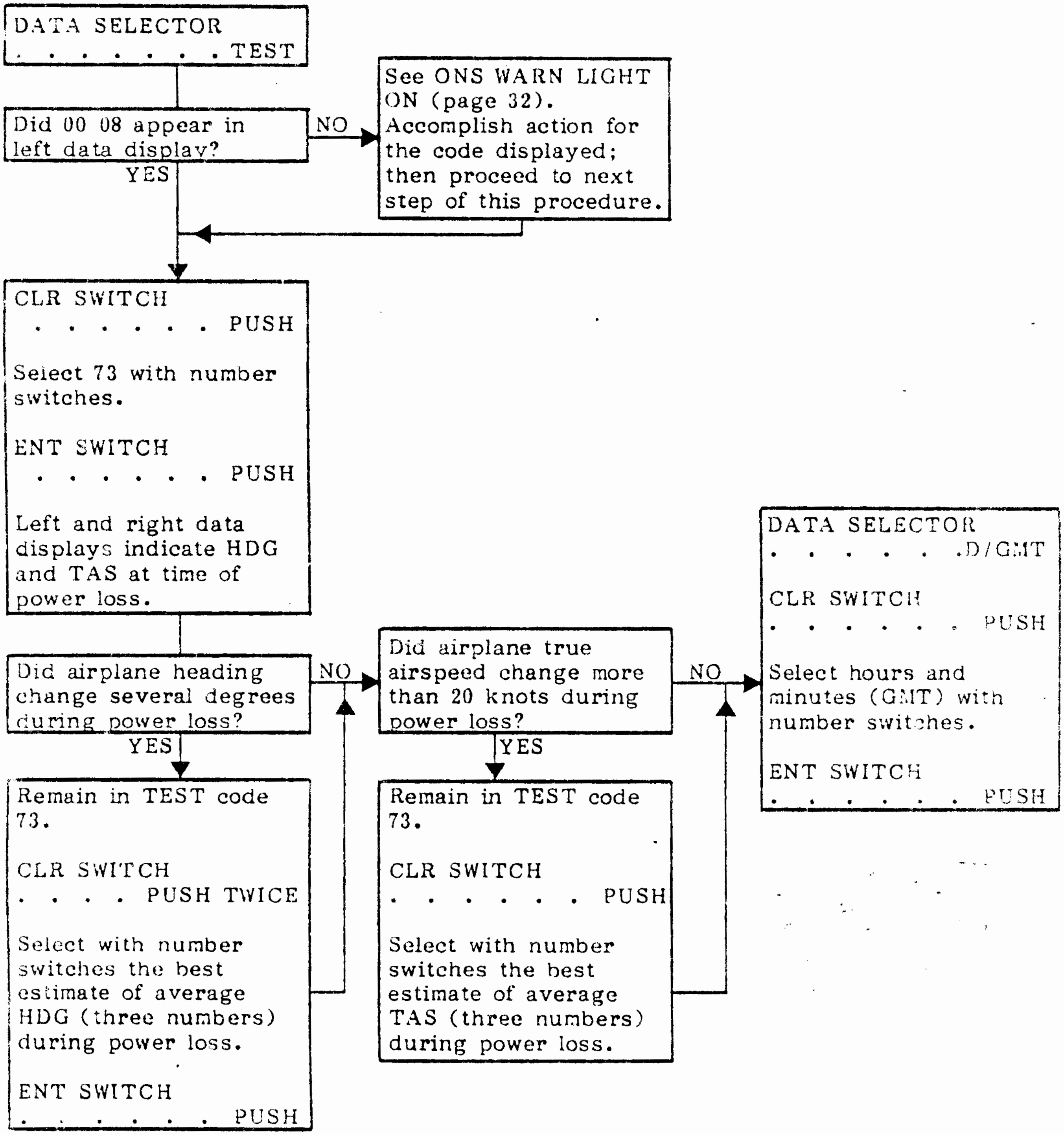
Left Data Display	Right Data Display	Malfunction	Action
00 01 (X)	R	Memory fault (RPU)	Maint-Replace RPU
00 02	A	Loop A, fault (ACU)	Maint-Replace ACU
00 03	A	Loop B, fault (ACU)	Maint-Replace ACU
00 04		Oscillator needs adjustment but system is usable.	Maint-Adjust oscillator. *
00 05	C	Faulty switch (CDU)	Maint-Check CDU switches for proper function. Replace CDU. *
00 06		TAS invalid/absent	Enter TAS manually.
00 07		HDG invalid/absent	Enter HDG manually.
00 08		Power loss greater than 7 seconds	Accomplish ONS POWER INTERRUPTION GREATER THAN 7 SECONDS BUT LESS THAN 7 MIN (Pg-34)
00 09	R	Front end (RPU) 10.2 kHz channel	Computer will automatically stop
00 10	R	Front end (RPU 13.6 kHz channel	using signals from the bad channels. WARN
00 11	R	Front end (RPU) 11.33 kHz channel	light goes off when TEST is selected
00 12	R	Front end (RPU) VLF channel	unless all four channels fail. *
00 13 Not used by UA 00 14 Not used by UA 00 15 Not used by UA 00 16 Not used by UA			The symbol * indicates WARN light goes off when test is selected.

ONS POWER INTERRUPTION LESS THAN 7 SECONDS

When power is interrupted for less than 7 seconds, normal navigation is not disturbed. The D, R and SYNC lights come on. If on the ground, the HOLD light comes on indicating that ramp protect is on. The D, R and SYNC lights go off when the ONS resynchronizes and returns to primary navigation mode. No crew action is required. ETA will be up to 7 seconds slow.

ONS POWER INTERRUPTION GREATER THAN 7 SECONDS BUT LESS THAN 7 MINUTES

When power is restored, the ONS automatically resynchronizes and begins dead reckoning from position at time of power interruption. The WARN, SYNC and D, and R lights come on. Accomplishing the following procedure causes the ONS to automatically perform a lane resolution and return to primary navigation mode.



DATA SELECTOR . . . . TEST

Did 00 08 appear in left data display?

See ONS WARN LIGHT ON (page 32). Accomplish action for the code displayed; then proceed to next step of this procedure.

CLR SWITCH . . . . PUSH

Select 73 with number switches.

ENT SWITCH . . . . PUSH

Left and right data displays indicate HDG and TAS at time of power loss.

Did airplane heading change several degrees during power loss?

Remain in TEST code 73.

CLR SWITCH . . . . . PUSH TWICE

Select with number switches the best estimate of average HDG (three numbers) during power loss.

ENT SWITCH . . . . PUSH

Did airplane true airspeed change more than 20 knots during power loss?

Remain in TEST code 73.

CLR SWITCH . . . . PUSH

Select with number switches the best estimate of average TAS (three numbers) during power loss.

DATA SELECTOR . . . . . . .D/GMT

CLR SWITCH . . . . PUSH

Select hours and minutes (GMT) with number switches.

ENT SWITCH . . . . PUSH

ONS POWER INTERRUPTION GREATER THAN 7 MINUTES

Accomplish following procedure when power is restored:

Determine best estimate of the coordinates of predicted position (a position to be reached in one to two minutes). The ideal situation is to overfly a ground based navigation aid such as a VOR station.

AMR SELECTOR . . . . OFF, THEN A
  Clears memory.

DATA SELECTOR . . . . HDG/TAS

CLR SWITCH. . . . . PUSH

Select true airspeed (three numbers) with number switches.

ENT SWITCH . . . . PUSH

DATA SELECTOR . . . . D/GMT

Select month (01-12) and day (01-31) with number switches.

ENT SWITCH . . . . PUSH

Select GMT (hours, minutes, seconds) with number switches.

ENT SWITCH. . . . . PUSH

When airplane is directly over the position for which the coordinates were determined:

DATA SELECTOR . . . . POS

Select coordinates of present position with number switches.

ENT SWITCH . . . . PUSH

DATA SELECTOR . . . . WPT
  The number 1 appears in the left data display.

Select coordinates of next waypoint with number switches.

ENT SWITCH . . . . PUSH

Enter remaining waypoints using the same procedure.

SECTION 19

SWING TAIL

1. General (Ref. Fig. 1)

The swing-tail system enables the aft section of the fuselage to be swung open to starboard to facilitate cargo loading. Two hinges on the starboard side of the fuselage support the tail when unlocked and, together with shear wedges and eight hydraulically actuated latch pins, transfer structural loads between the fuselage and the tail when the tail is closed and locked.

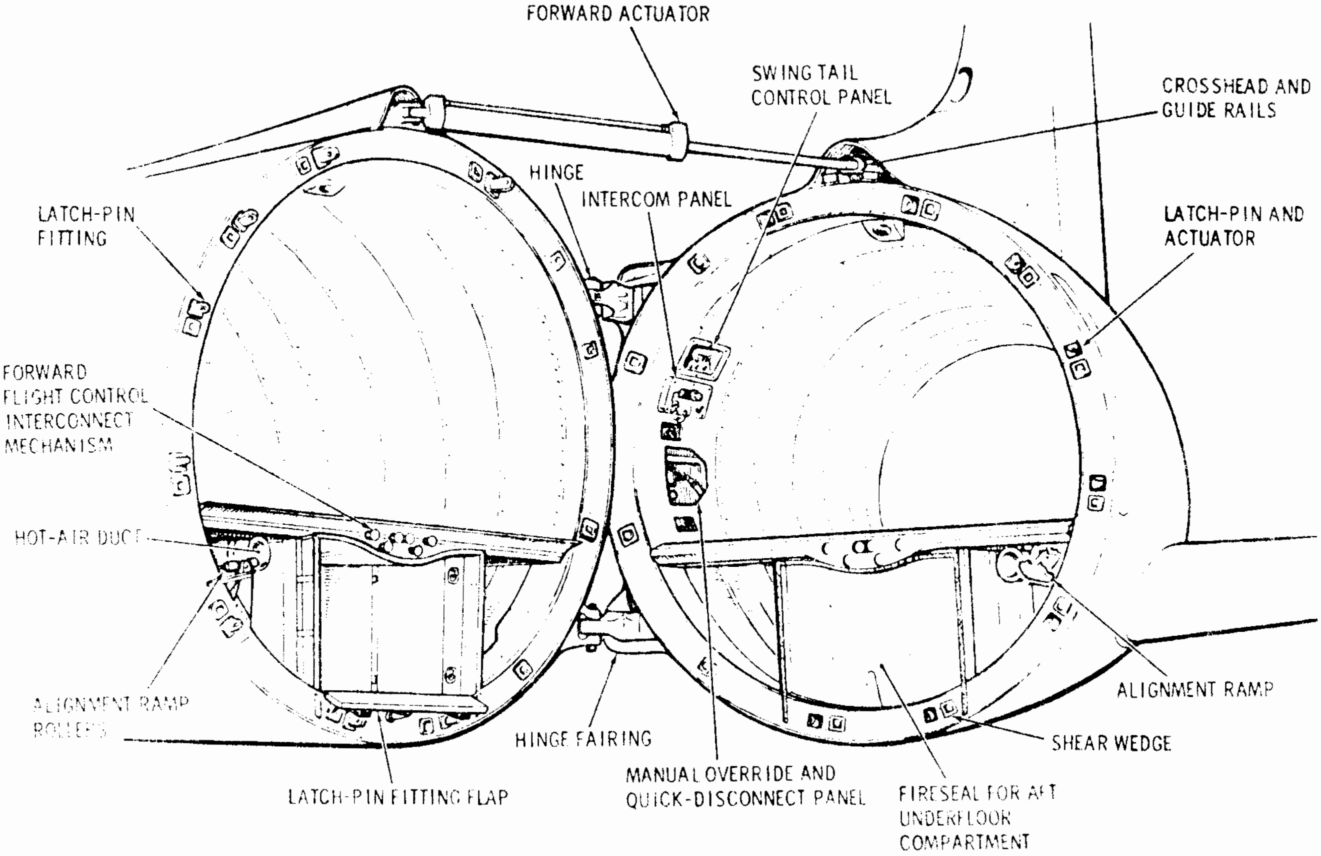
The tail is opened and closed by two hydraulic actuators operating in tandem and located in the dorsal fin. Eight latch pins lock the tail in the closed position, each pin being inserted and withdrawn by a hydraulic actuator. The system is supplied with hydraulic pressure from the hydraulic power system. An auxiliary electrically driven pump is installed in the aircraft and can be used to pressurize the main hydraulic power system for the operation of the swing tail. Electrical and mechanical sequencing of the main and latch pin actuators ensures correct operation during both the opening and closing cycles. Hydraulic and pneumatic lines are connected from the fuselage into the swing tail through swivel joints and flexible hoses at the lower hinge. As a safety feature, the hydraulic pressure line incorporates a quick-disconnect fitting. The line is disconnected and stowed during flight, making it impossible to unlock the tail.

An inflatable seal, attached to the swing tail, is installed around the break to prevent the leakage of cabin pressure from the fuselage. Control of the seal is automatic. A static weather seal is attached to the fuselage and prevents the ingress of water when the pressure seal is not inflated.

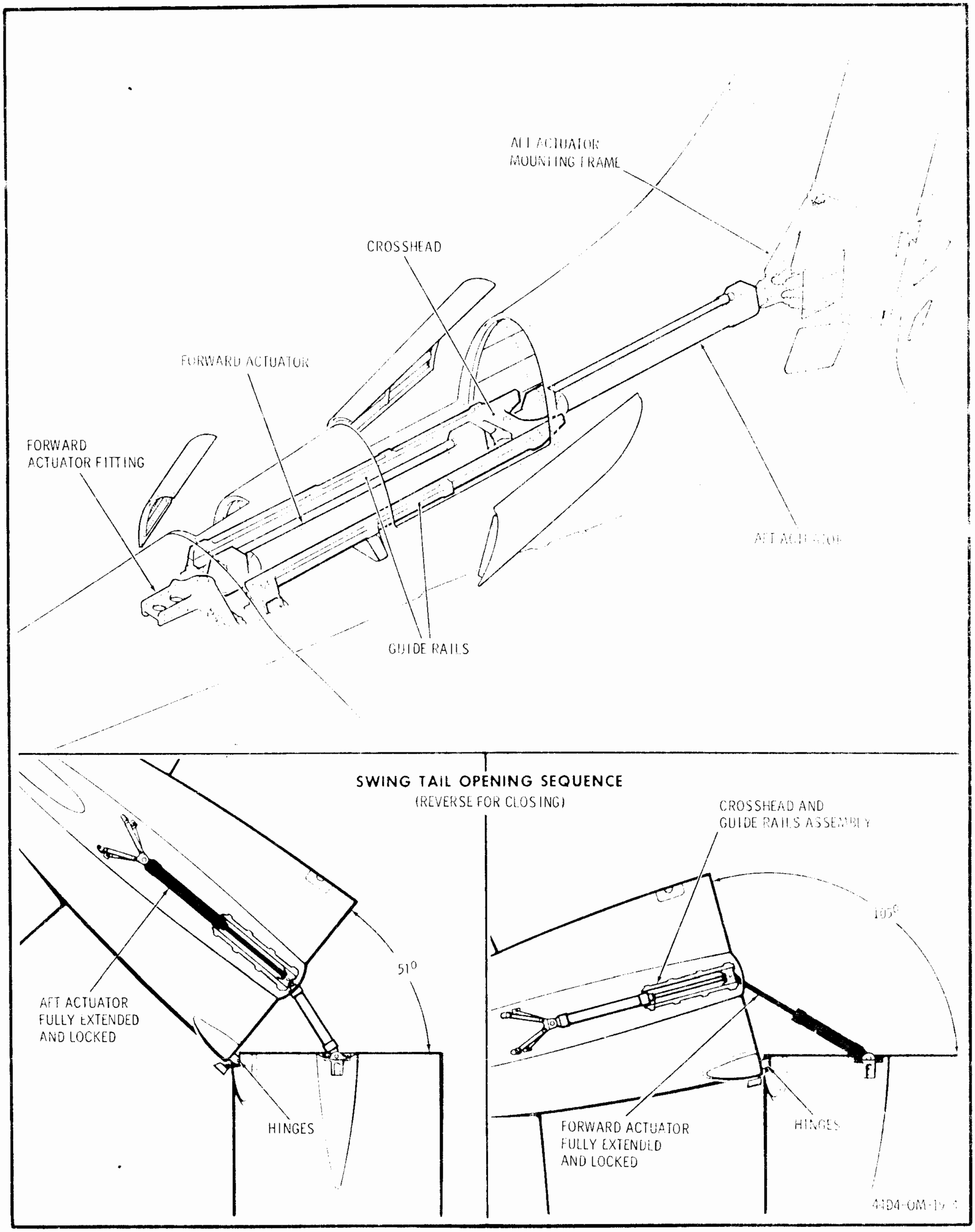
The elevator, elevator trim and rudder controls are transferred across the swing-tail break by gear-boxes and push-rods. In each control run, a gear-box with two push-rods is located on each side of the break. Each pair of push-rods abut when the tail is closed to transfer the control movement.

2. Hydraulic Actuators (Ref. Fig. 2)

The swing tail is opened and closed by two double-acting hydraulic actuators in tandem, located in the dorsal fin above the swing-tail break. The cylinder end of the forward actuator is connected to the fuselage structure while the piston-rod is connected to the aft actuator piston-rod. The two piston-rod eye



Swing Tail - General Assembly
Figure 1



Swing-tail Main Actuators
Figure 2

ends are supported in a crosshead-type guide located in the dorsal fin of the tail structure. The cylinder end of the aft actuator is connected to the vertical stabilizer through a tubular frame.

The forward actuator incorporates two internal locks which lock the actuator at each end of its stroke. The aft actuator has one internal lock which engages when the actuator is fully extended. The locks release automatically when a reverse selection is made. During the opening cycle, the aft actuator extends first while, during the closing cycle, the forward actuator reacts first. The actuator sequencing is controlled by a lock-operated sequence valve integral with each actuator, two electrically operated solenoid valves and two pressure-operated check valves. To reduce the rate of opening and the load on the mechanism, restrictors are installed in the two ports in each actuator and the pressure of the supply to the extension ports of the actuators is reduced. A microswitch on the forward actuator is energized when the actuator is fully extended and locked, illuminating a light marked OPEN & LOCKED on the swing-tail control panel.

3. Crosshead and Guide Rails

A crosshead-type slider, sliding within two rails, supports and guides the two actuator piston-rod ends. The two rails are secured to the tail section and a 90° [illegible] slot in each rail form the bearing surface for the crosshead. A brush at each end of the slider keeps the surface of the rails free from contamination by dirt.

4. Fuselage Alignment Ramp

To raise the swing tail into correct alignment with the fuselage during the closing cycle and to provide a gradual transfer of load during opening, an alignment ramp is provided on the port side of the fuselage. The ramp consists of a curved track in the swing tail which engages with two rollers in a trunnion on the fuselage section. When the tail is open and locked, the ramp is retracted manually to provide free access for loading operations. A microswitch breaks the circuit to the swing tail controls when the ramp is retracted, making it impossible for the tail to be electrically selected closed when the ramp is out of position.

Final alignment of the swing tail and fuselage is provided by twelve shear wedges fitted on the tail section with matching receptacles on the fuselage.

5. Latch Pin Fitting Flap

A retractable flap is located at the rear of the lower hold at the swing-tail break. When the tail is open, the flap is lowered automatically to protect the two lowest latch pin fittings during loading and is retracted as the tail is closed. The flap is operated by a cam and lever assembly through a cable and push-rod, the cam being located on the swing tail and the lever below the cabin floor on the starboard side of the fuselage.

The flap is pulled into the down position by a tension spring. As the tail is closed, the cam contacts the lever and, through the cable, raises the flap to a vertical position against the tension of the spring.

6. Locking Actuators (Ref. Fig. 3)

The eight latch pins are each engaged and withdrawn by a double-acting hydraulic actuator. The latch pins are positively engaged in the locked position by double ball locks in each pin and an internal lock in the actuator. Two microswitches are incorporated in each assembly and are operated one at each end of the actuator stroke. The microswitches at the locked end of the stroke, in conjunction with a microswitch at the hydraulic pressure quick-disconnect coupling stowage plug, control an open warning light on the control panel and the pilots annunciator panel indicators. The microswitches at the unlocked position sequence the main actuator selector valve, maintain power to the pressure seal valve and operate the latch pins out warning light on the control panel.

7. Swing-tail Seals

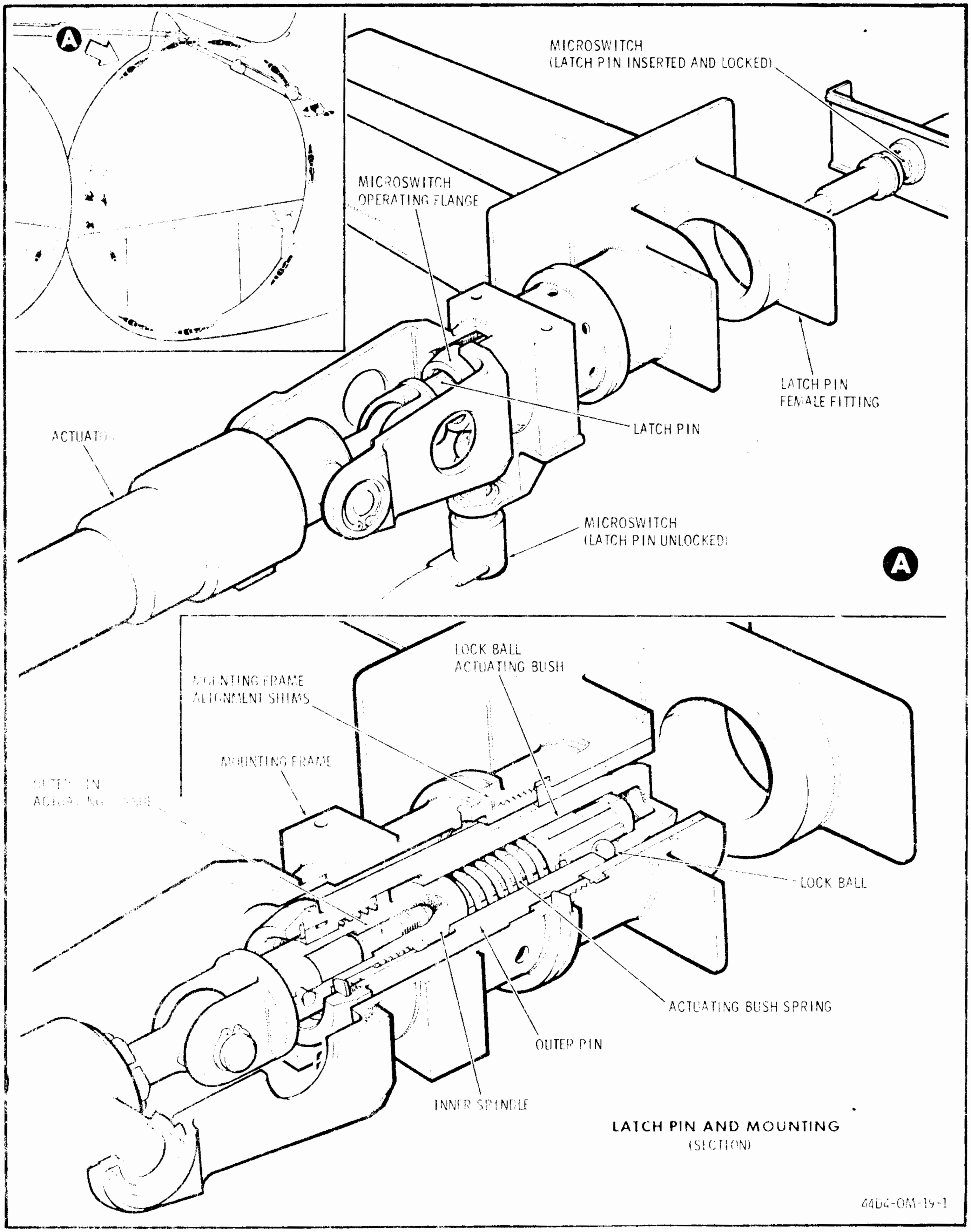
Two seals are installed at the swing-tail break, a pressure seal and a weather seal. The weather seal consists of a tubular rubber seal retained in a groove in the fuselage section and a mating projection in the swing tail. When the tail is closed and locked, the seal is compressed and effectively seals out moisture and dirt when the aircraft is unpressurized.

The pressure seal is inflated with air pressure at 12 psi from the pneumatic system. The seal is retained in an extrusion on the swing-tail frame and consists of a continuous tubular rubber seal with a serrated projection. When the seal is pressurized, the projection contacts the sealing face on the fuselage to seal the break. The air supply is controlled by a three-way two-position solenoid valve.

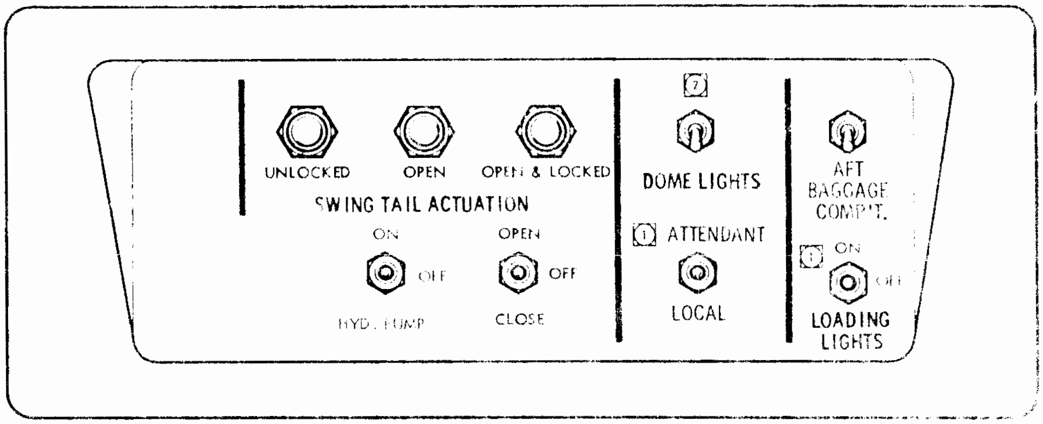
The valve is supplied with air from the pneumatic system power pack through a swivel fitting and a flexible hose at the swing-tail break. When the valve solenoid is de-energized, the pressure is directed to the seal and, when energized, shuts off the supply and vents the seal to atmosphere. The valve is energized from the 28-volt d.c. main bus through both the swing-tail control switch and the swing-tail lock pins microswitches.

8. Swing-tail Control Panel (Ref. Fig. 4)

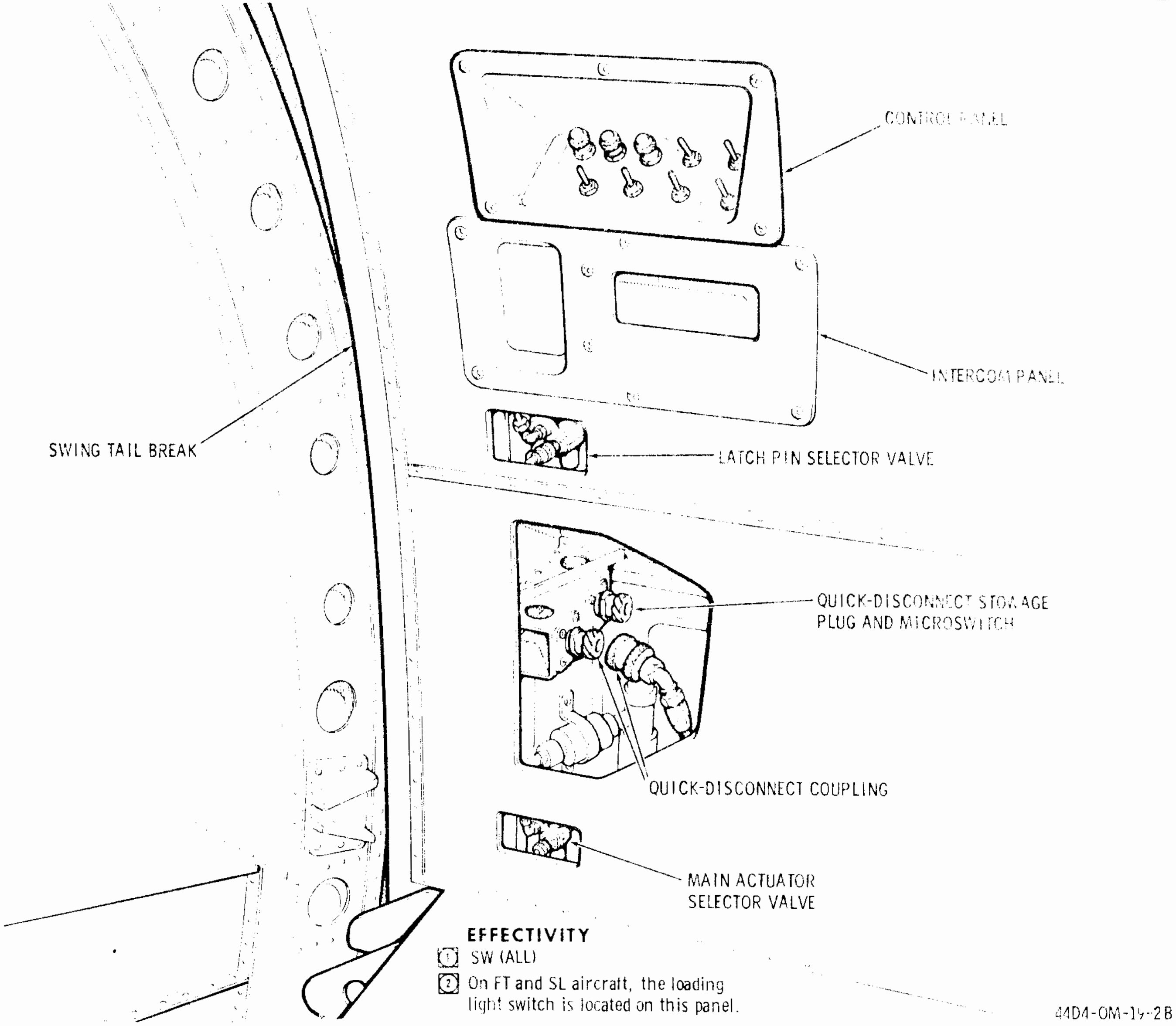
The control panel is located on the starboard side of the swing-tail section,



Swing-tail Latch Pin and Actuators
Figure 3



SWING TAIL CONTROL PANEL


CONTROL PANEL
INTERCOM PANEL
LATCH PIN SELECTOR VALVE
SWING TAIL BREAK
QUICK-DISCONNECT STORAGE PLUG AND MICROSWITCH
QUICK-DISCONNECT COUPLING
MAIN ACTUATOR SELECTOR VALVE

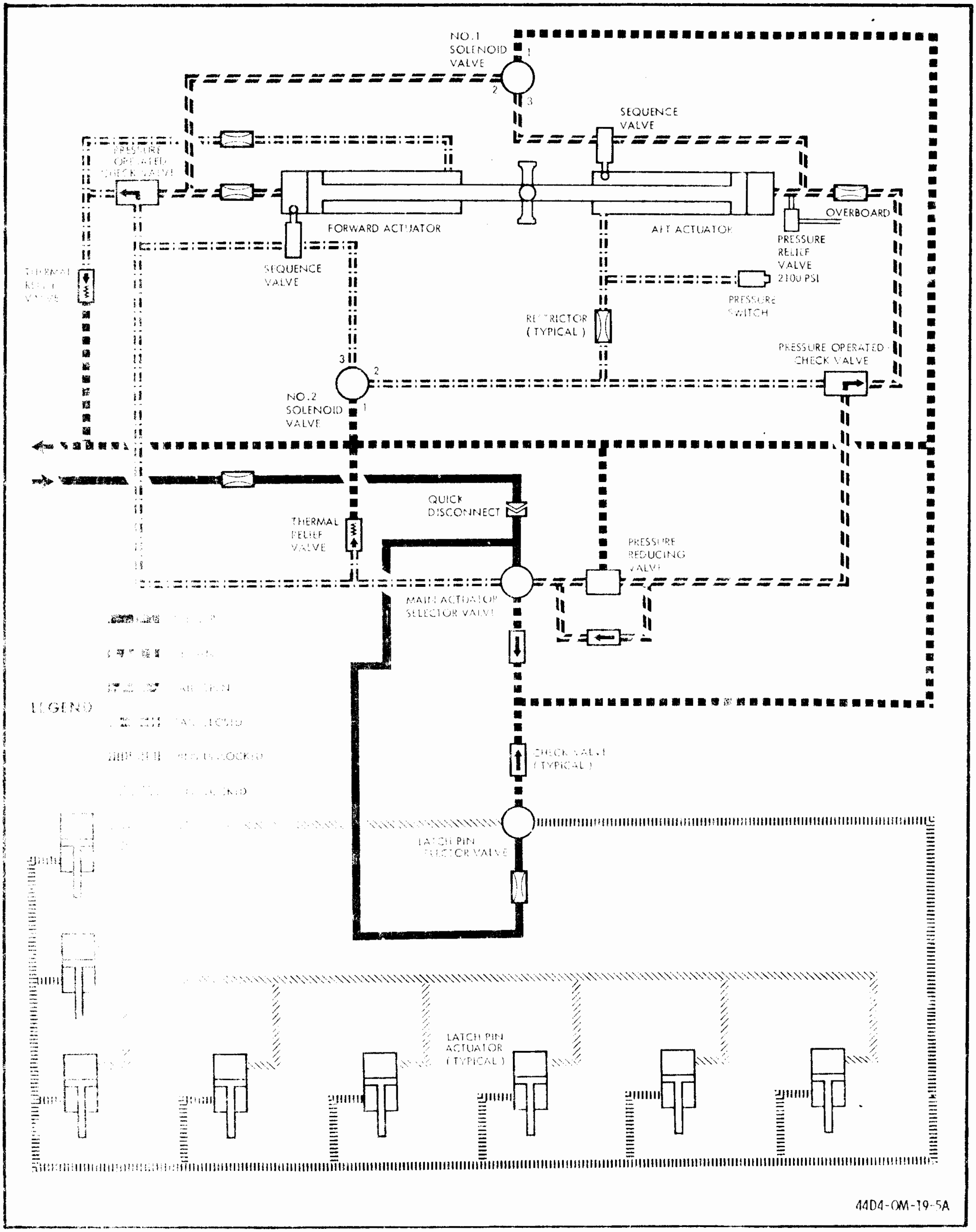
EFFECTIVITY

1 SW (ALL)

2 On FT and SL aircraft, the loading light switch is located on this panel.

44D4-OM-19-2B

Swing-tail Control Panel
Figure 4



Swing Tail - Schematic
Figure 5

just aft of the fuselage break. The panel contains a three-position switch and three indicator lights. The switch is marked OPEN, OFF, and CLOSE, and controls the operation of the swing tail. It is spring loaded to the OFF position.

The three warning lights indicate various conditions of the swing tail. An amber light marked OPEN is illuminated when the tail is not completely and correctly closed and locked and the quick-disconnect not in its stowed position. A green light marked OPEN & LOCKED is illuminated when the tail is fully open. A second green light marked UNLOCKED is illuminated when all eight of the latch pins are fully retracted and the control switch is in the OFF or OPEN position. Indication that the tail is not closed and locked or that the quick-disconnect is not properly stowed is also given on the pilots annunciator panel windows marked SWING TAIL OPEN and on the master caution lights.

Other switches on the panel control the auxiliary hydraulic pump, the dome lights, the loading lights, and the aft baggage compartment lights.

9. Swing-tail Hydraulic Panel

Two solenoid-operated valves are mounted in cutaways below the swing-tail control panel. One valve controls the fluid to the main actuator and the other supplies fluid to the locking actuators. Operation of the valves is automatic, but manual override is provided on both valves for maintenance purposes.

The quick-disconnect fitting is also located at this position and consists of a pressure fitting and a stowage fitting. The windows on the pilots annunciator panels marked SWING TAIL OPEN will be illuminated any time the quick-disconnect line is not in the stowed position. A detachable panel is provided to cover the cutaways when not in use.

10. Operation (Ref. Fig. 5)

Before it is possible to operate the swing tail, the following conditions must be met. The aircraft must be on the ground with the ground safety relay energized. The quick-disconnect fitting must be on the pressure line, the alignment ramp in the normal position, and hydraulic and electrical power available.

On selecting OPEN on the swing-tail control switch, the main actuator selector valve is selected to the closed position to direct pressure to the closing lines of both actuators, to the latch pin selector valve, and to a pressure switch. The latch pin selector valve remains in the neutral position. The pressure is directed to the aft actuator to apply a closing force to the swing tail and remove the loads from the latch pins. When the pressure to the aft actuator reaches 2500 psi, the pressure switch is actuated to energize the latch pin selector valve to the unlocked position. This directs fluid to the latch pin actuators to withdraw the latch pins. A holding relay, in parallel with the pressure switch, will maintain the latch pin selector valve in the retract position, independent of the pressure switch.

When all the pins are fully withdrawn, the unlocked microswitch at each of the latch pin actuators are connected in series to complete the circuit to the main actuator selector valve relay. This relay reselects the main actuator selector valve from the closed to the open position to direct the pressure to a reducing valve. The reducing valve reduces the pressure supply to 950 psi for extension of the two swing-tail actuators. From the pressure reducing valve, the flow is led, through a pressure-operated check valve in the free flow direction to the extension port of the aft actuator to extend the actuator and partially open the swing tail. The actuator is locked in the fully extended position by an internal lock which actuates the integral sequence valve and a microswitch. The sequence valve directs pressure fluid supplied from the pressure reducing valve to the No.1 solenoid valve. The microswitch de-energizes the No.1 solenoid valve to direct the pressure fluid through a restrictor to the extension port of the forward actuator and to the operating port of the forward pressure-operated check valve. The pressure unlocks and extends the forward actuator and opens the pressure-operated check valve to permit the fluid exhausted from the forward actuator to return to the reservoir. When the actuator is fully extended, the internal lock engages, operating a microswitch which illuminates the light marked OPEN & LOCKED on the swing-tail control panel.

Selection of the swing-tail control switch to the CLOSE position energizes the main actuator selector valve to the close position and the latch pin selector valve to the unlock position. The main actuator selector valve directs the pressure to the latch pin selector valve and to a pressure-operated check valve. The pressure is directed through the pressure-operated check valve in the free flow direction to release the internal lock and retract the forward actuator. Return fluid from the forward actuator is directed to re [illegible] the energized No. 1 solenoid valve.

When the forward actuator is fully retracted and the internal lock engaged, the sequence valve is actuated by the lock, and No.2 solenoid valve is de-energized. The sequence valve and the No.2 solenoid valve direct pressure fluid from the forward actuator to retract the aft actuator. This pressure also acts on the aft pressure-operated check valve to direct return fluid from the aft actuator to return to the reservoir through the main actuator selector valve.

On reaching the fully retracted position, the microswitch energizes the latch pin selector valve to direct the pressure to extend the latch pin actuators and engage the pins. An internal lock in each actuator and the lock balls in the latch pins automatically engage to lock the pins in the locked position. The amber OPEN warning light and the pilots and the co-pilots annunciator panel windows marked SWING TAIL OPEN remain on after the tail is locked until the quick-disconnect coupling is in the stowage plug.

11. Power Source

Power source for the actuation and control of the swing-tail system is as follows:

(1) D.C. Main	Quantity
Swing Tail - Hyd Pump Motor Control	1
Swing Tail - Control	1

SECTION 20

WEIGHT AND BALANCE

1. Weight and Balance

For details of weight and balance, refer to Volume I, Section 7, General Company Policies Manual.

SECTION 20

WEIGHT AND BALANCE

1. Weight and Balance

For details of weight and balance for SW, FT and SL aircraft, refer to Report No. RAW-44-117. For aircraft 35 and 36, refer to Report No. RAW-44-165.

2. Cargo Capacity and Size Limitations

For cargo capacity and size limitations, refer to Figure 1.

3. Swing Tail Compartment Cargo Capacity Restrictions (Ref. Fig. 1, Sheet 3)

When carrying a cargo load in excess of 3000 pounds in the swing tail compartment, the following restrictions apply:

A. The centre of gravity limits set forth in RAW-44-117 Weight and Balance Handbook, Appendix A, must be observed.

B. The centre of gravity of the load in the swing tail compartment must be forward of Station 1290 and outboard 20 inches, measured to the right of the aircraft centre-line.

C. The accumulated fuselage load shall be in accordance with the data contained in Figure 1, Sheet 3, D4 Aircraft With Standard Cargo Floor in Swing Tail and Incorporating Modification Summary 44-346.

D. It is to be noted that Modification Summary 44-346 applies only to the basic cargo configuration and not to aircraft incorporating Modification Summary 44-335 (lowered floor).

E. For loads of 3000 pounds or less, the data contained in the basic RAW-44-117, Weight and Balance Handbook, apply.

4. Swing Tail Compartment Cargo Capacity Restrictions (Ref. Fig. 1 Sheet 4)

The following restrictions apply to those aircraft which incorporate structural provisions for increased swing tail compartment cargo capacity per Modification Summaries 44-335 and 44-364.

The cargo load capacity of the swing tail compartment may be increased above 1000 pounds provided the following limitations are observed:

A. The total load of cargo and removable items (i.e. toilets, partitions, galleys or all installations in the swing tail compartment other than fixed provisions) must not exceed 4200 pounds.

B. The maximum load on the cargo floor forward of Station 1303 must not exceed 3200 pounds.

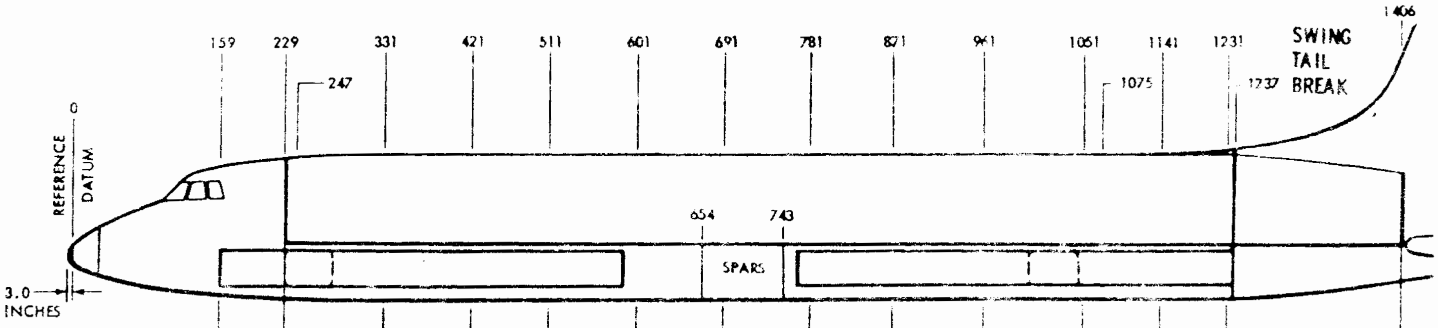
C. The moment of the cargo and removable items, as described in Paragraph A, about the hinge line at Station 1228.5 with the lever arms measured parallel to the longitudinal axis of the swing tail must not exceed 258,000 inch-pounds.

D. The moment of the cargo and removable items, as described in Paragraph A, about the hinge line at buttock line 68 RH with the lever arms measured perpendicular to the longitudinal axis and buttock line 68 RH must not exceed 201,500 inch-pounds.

E. The weight of cargo which may be fastened down directly to the seat rail for crash restraint must not exceed 1400 pounds, the balance to be carried by the barrier net forward of Station 1231.

F. The accumulated fuselage load shall be in accordance with the data contained in Figure 1, Sheet 4, D4 Aircraft Incorporating Modification Summaries 44-364 and 44-335.

G. For SW, FT and SL aircraft, the centre of gravity limits as set forth in RAW-44-117, Weight and Balance Handbook, Appendix B must be observed. For centre of gravity limits for aircraft 35 and 36, refer to RAW-44-165.



NOTE

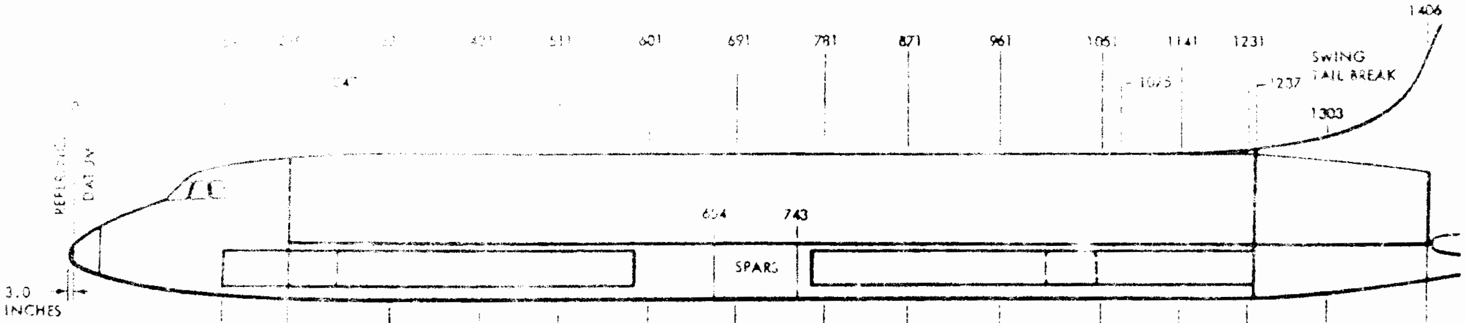
No cargo is loaded above floor between Stations 229 and 247 as this is an equipment access area.

	A	B	C	D	E	F	G	H	J	K	L	M	N
MAXIMUM COMPARTMENT LOAD INCLUDING LOWER HOLDS (POUNDS)		7700	8250	8250	8250	8250	8250	8250	8250	8250	5630	4950	3000
ACCUMULATED LOAD FORWARD/AFT OF THESE STATIONS NOT TO EXCEED (POUNDS) (UPPER AND LOWER FLOORS COMBINED)		9160	15,460	21.760	28,060	35,160	37,490	30,060	23,760	17,460	11,160	6840	
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – ABOVE FLOOR (INCHES)		289	376	466	556	646	736	826	916	1006	1096	1186	1321
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – BELOW FLOOR (INCHES)		385						1005					
LENGTH OF COMPARTMENTS (INCHES)		84	90	90	90	90	90	90	90	90	90	90	169
MAXIMUM LOCAL FLOOR LOADING ABOVE FLOOR (POUNDS PER SQUARE FOOT)	200					300		200					150
MAXIMUM LOCAL FLOOR LOADING BELOW FLOOR (POUNDS PER SQUARE FOOT)	75							75					
VOLUME ABOVE FLOOR (CUBIC FEET)		564	496	501	501	491	491	501	501	501	501	526	720
VOLUME BELOW FLOOR (CUBIC FEET)	523							586					
MAXIMUM LOADS IN LOWER COMPARTMENTS (POUNDS)	10,775 EVENLY DISTRIBUTED							11,560 EVENLY DISTRIBUTED					

44D4-OM-20-18

Cargo Capacity and Load Limitations - D4 Aircraft with Standard Cargo Floor in Swing Tail Compartment

Figure 1 (1 of 4)



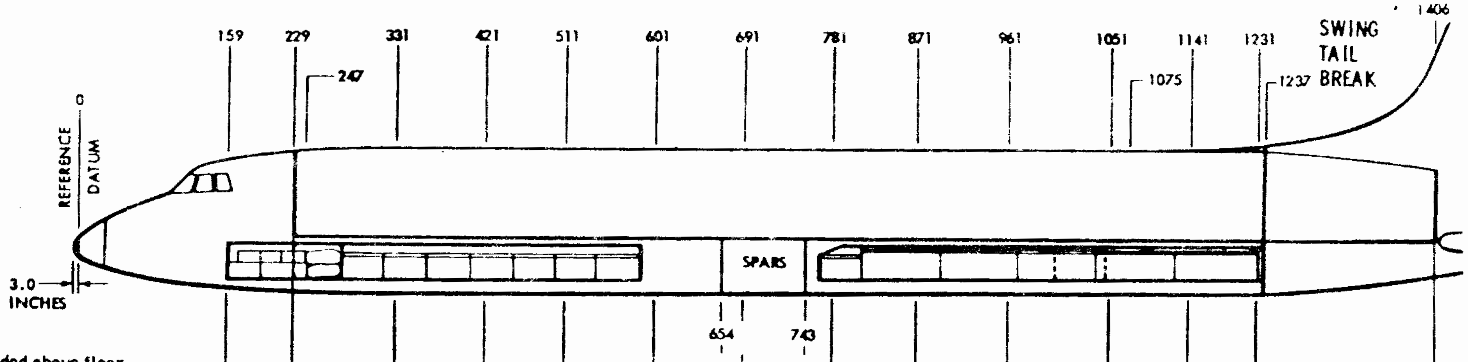
NOTE

No cargo is loaded above floor between Stations 229 and 247 as this is an equipment access area.

	A	B	C	D	E	F	G	H	J	K	L	M	N
MAXIMUM COMPARTMENT LOAD INCLUDING LOWER HOLDS (POUNDS)		7700	8250	8250	8250	8250	8250	8250	8250	8250	5830	4950	1000
ACCUMULATED LOAD FORWARD/AFT OF THESE STATIONS NOT TO EXCEED (POUNDS) (UPPER AND LOWER FLOORS COMBINED)		9160	15,460	21,760	28,060	35,160	37,107	29,680	23,380	17,080	10,780	5800	
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – ABOVE FLOOR (INCHES)		289	376	466	556	646	736	826	916	1006	1096	1186	1270
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – BELOW FLOOR (INCHES)		385						1006					
LENGTH OF COMPARTMENTS (INCHES)		84	90	90	90	90	90	90	90	90	90	90	66
MAXIMUM LOCAL FLOOR LOADING ABOVE FLOOR (POUNDS PER SQUARE FOOT)	200					300		200					150
MAXIMUM LOCAL FLOOR LOADING BELOW FLOOR (POUNDS PER SQUARE FOOT)	75							75					
VOLUME ABOVE FLOOR (CUBIC FEET)		564	496	501	501	491	491	501	501	501	501	526	320
VOLUME BELOW FLOOR (CUBIC FEET)	523							586					
MAXIMUM LOADS IN LOWER COMPARTMENTS (POUNDS)	10,775 EVENLY DISTRIBUTED							11,560 EVENLY DISTRIBUTED					

44D4-OM-20-2A

Cargo Capacity and Load Limitations - D4 Aircraft with Modification Summary 44-335 Incorporated but Excluding Modification Summary 44-364
Figure 1 (2 of 4)



NOTE

No cargo is loaded above floor between Stations 229 and 247 as this is an equipment access area.

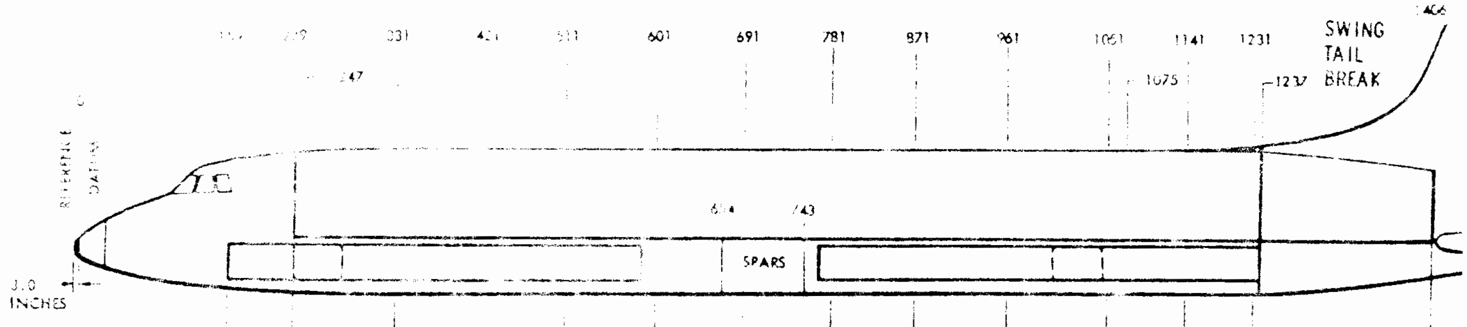
	A	B	C	D	E	F	G	H	J	K	L	M	N
MAXIMUM COMPARTMENT LOAD INCLUDING LOWER HOLDS (POUNDS)		7700	8250	8250	8250	8250	8250	8250	8250	8250	5830	4950	4200
ACCUMULATED LOAD FORWARD/AFT OF THESE STATIONS NOT TO EXCEED (POUNDS) (UPPER AND LOWER FLOORS COMBINED)		9160	15,460	21,760	28,060	35,160	38,690	31,260	24,960	18,660	12,360	8040	
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – ABOVE FLOOR (INCHES)		289	376	466	556	646	736	826	916	1006	1096	1186	*
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – BELOW FLOOR (INCHES)		385						1006					
LENGTH OF COMPARTMENTS (INCHES)		84	90	90	90	90	90	90	90	90	90	90	169
MAXIMUM LOCAL FLOOR LOADING ABOVE FLOOR (POUNDS PER SQUARE FOOT)	200					300		200					150
MAXIMUM LOCAL FLOOR LOADING BELOW FLOOR (POUNDS PER SQUARE FOOT)	75							75					
VOLUME ABOVE FLOOR (CUBIC FEET)		564	496	501	501	491	491	501	501	501	501	526	720
VOLUME BELOW FLOOR (CUBIC FEET)	523							586					
MAXIMUM LOADS IN LOWER COMPARTMENTS (POUNDS)	10,775 EVENLY DISTRIBUTED							11,560 EVENLY DISTRIBUTED					

* THE CENTRE OF GRAVITY FOR THE 4200 POUNDS IS TO BE FORWARD OF STATION 1290 AND OUTBOARD 20 INCHES, MEASURED TO THE RIGHT OF THE AIRCRAFT CENTRE LINE.

44D4-OM-20-3

Cargo Capacity and Load Limitations - D4 Aircraft with Standard Cargo Floor in Swing Tail Compartment and Incorporating Modification Summary 44-346

Figure 1 (3 of 4)



NOTE

No cargo is loaded above floor between Stations 229 and 247 as this is an equipment access area.

	A	B	C	D	E	F	G	H	J	K	L	M	N
MAXIMUM COMPARTMENT LOAD INCLUDING LOWER HOLDS (POUNDS)		7700	8250	8250	8250	8250	8250	8250	8250	8250	5830	4950	4200 SEE NOTE 3
ACCUMULATED LOAD FORWARD/AFT OF THESE STATIONS NOT TO EXCEED (POUNDS) (UPPER AND LOWER FLOORS COMBINED)		[illegible] ◆	15,450 ◆	21,760 ◆	28,960 ◆	35,160 ◆	◆ 38,690	◆ 31,260	◆ 24,960	◆ 18,660	◆ 12,360	◆ 8040	
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – ABOVE FLOOR (INCHES)		289	376	466	556	646	736	826	916	1006	1096	1166	SEE NOTE 1 & 2
COMPARTMENT CG POSITIONS AFT OF REFERENCE DATUM – BELOW FLOOR (INCHES)		385						1006					
LENGTH OF COMPARTMENTS (INCHES)		64	90	90	90	90	90	90	90	90	90	90	169
MAXIMUM LOCAL FLOOR LOADING ABOVE FLOOR (POUNDS PER SQUARE FOOT)	200					300		200					150 40
MAXIMUM LOCAL FLOOR LOADING BELOW FLOOR (POUNDS PER SQUARE FOOT)	75							75					
VOLUME ABOVE FLOOR (CUBIC FEET)		564	496	501	501	491	491	501	501	501	501	526	720
VOLUME BELOW FLOOR (CUBIC FEET)	[illegible]							586					
MAXIMUM LOADS IN LOWER COMPARTMENTS (POUNDS)	10,775 EVENLY DISTRIBUTED							11,560 EVENLY DISTRIBUTED					

NOTES

1 THE MOMENT OF THE CARGO AND REMOVABLE ITEMS (ALL INSTALLATIONS OTHER THAN FIXED EQUIPMENT) ABOUT THE HINGE LINE AT STATION 1226.5 WITH THE LEVER ARMS MEASURED PARALLEL TO THE LONGITUDINAL AXIS OF THE SWING TAIL MUST NOT EXCEED 258,000 INCH-POUNDS.

2 THE MOMENT OF THE CARGO AND REMOVABLE ITEMS (ALL INSTALLATIONS OTHER THAN FIXED EQUIPMENT) ABOUT THE HINGE LINE AT B L 68 RH WITH THE LEVER ARMS MEASURED PERPENDICULAR TO THE LONGITUDINAL AXIS AND B L 68 RH MUST NOT EXCEED 201,500 INCH-POUNDS.

3 FOR LIMITATIONS REFER TO TEXT.

44D4-GM-20-4

Cargo Capacity and Load Limitations - D4 Aircraft Incorporating Modification Summaries 44-364 and 44-335
Figure 1 (4 of 4)

SECTION 21

MISCELLANEOUS

1. Furnishings

A. Flight Compartment

Vinyl-encased glass fiber insulating blankets are installed throughout the flight compartment to maintain adequate thermal and acoustic insulation. Removable trim panels made of versalite or vinyl coated fabric cover the compartment walls. The floor is made of aluminum honeycomb, surfaced with Durug, a durable vinyl material on a hair cell underlay.

B. Pilots' Stations

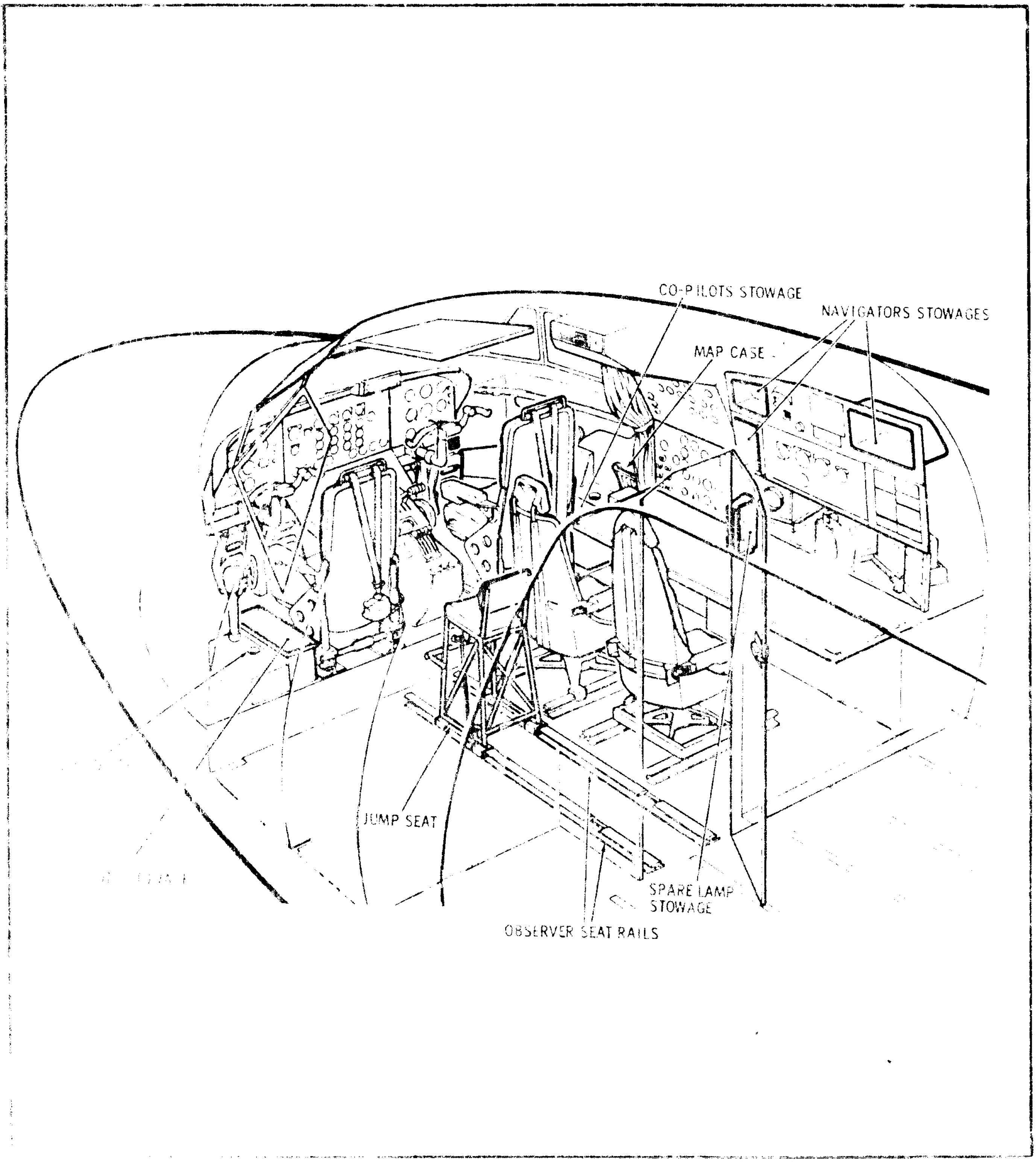
Basic construction of both pilots' seats is identical, left and right configuration being determined by the location of the seat. The seats are adjustable in the fore-and-aft and the vertical plane. Both seats are designated as crash positions and are fitted with shoulder harnesses and inertia reel locks. The inertia reel lock controls are situated on the outboard side of each seat and the vertical, fore-and-aft adjustment controls on the inboard side. The arm rests incorporate an ash tray in each arm and can be raised to the vertical position. A stowage box is bolted to the floor on the outboard side of each pilots seat and a map case is located to the right of the co-pilot.

C. Systems Operators Station

The systems operators seat is mounted on two lateral floor rails which permit the seat to be moved from the worktable to a position behind the pilots pedestal. Control of the seat on the floor rails is provided by two interconnected levers, one each side below the seat bucket. The vertical adjustment control lever is located on the right-hand side of the seat. The seat may be rotated through 90° from facing starboard to facing forward by operating a control lever on the left-hand side of the seat. The systems operators station is a crash position and the seat is equipped with a shoulder harness and inertia reel, the inertia reel control being situated on the left-hand side of the seat.

D. Navigators Station

The navigators seat is mounted on rails running athwartships and is also adjustable vertically. Two interconnected levers on the base control lateral adjustment and a lever on the right-hand side of the seat controls vertical movement. The seat bucket may be rotated through 360° in increments of 45°, the swiveling control being located on the underside of the seat bucket. A lap-type safety belt is provided and two crash cables with hooks on their free ends are attached


CO-PILOTS STOWAGE
NAVIGATORS STOWAGES
MAP CASE
JUMP SEAT
SPARE LAMP STOWAGE
OBSERVER SEAT RAILS

SECTION 21

MISCELLANEOUS

1. Furnishings

A. Flight Compartment (Ref. Fig. 1)

Vinyl-encased glass fibre insulating blankets are installed throughout the flight compartment to maintain adequate thermal and acoustic insulation. Removable trim panels made of versalite or vinyl coated fabric cover the compartment walls. The floor is made of aluminum honeycomb, surfaced with Durug, a durable vinyl material on a hair cell underlay.

B. Pilots Stations

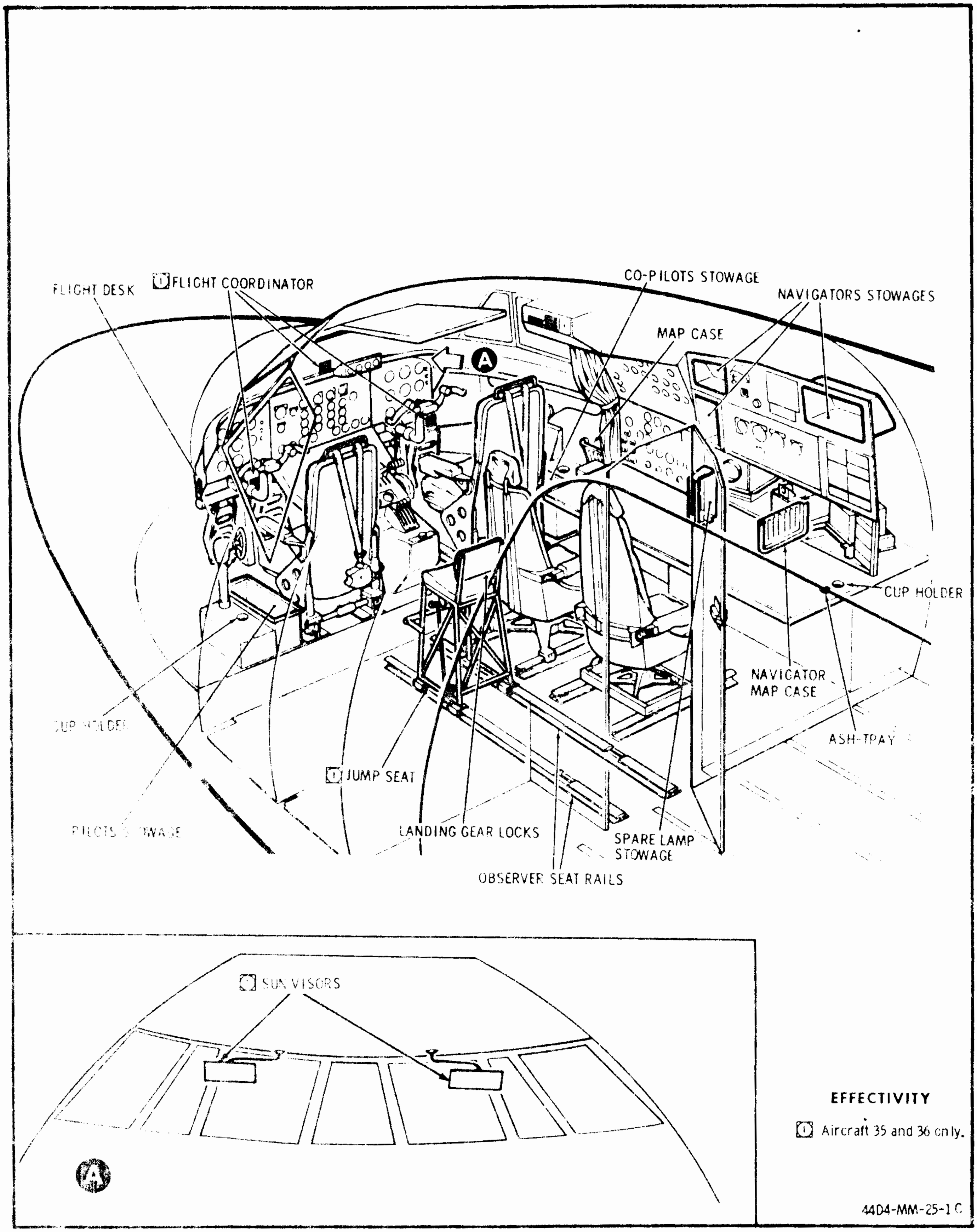
Basic construction of both pilots seats is identical, left and right configuration being determined by the location of the seat. The seats are adjustable in the fore-and-aft and the vertical plane. Both seats are designated as crash positions and are fitted with shoulder harnesses and inertia reel locks. The inertia reel lock controls are situated on the outboard side of each seat and the vertical, fore-and-aft adjustment controls on the inboard side. The arm rests incorporate an ash tray in each arm and can be raised to the vertical position. A stowage box is bolted to the floor on the outboard side of each pilots seat and a map case is located to the right of the co-pilot. A clipboard, for the use of the pilot, is stowed on the anti-glare shroud.

A flight co-ordinator is installed at both pilots stations. It consists of a box with a window through which items on a check list are visible. The check list may be advanced, item by item, by turning a knob on the side of the box. A light control is also located on the side of the box.

Cupholders are provided for both pilots. A blackout curtain separates the pilots from the systems operator.

C. Systems Operators Station

The systems operators seat is mounted on two lateral floor rails which permit the seat to be moved from the worktable to a position behind the pilots pedestal. Control of the seat on the floor rails is provided by two interconnected levers, one each side below the seat bucket. The vertical adjustment control lever is located on the right-hand side of the seat. The



EFFECTIVITY

1 Aircraft 35 and 36 only.

44D4-MM-25-1C

Flight Compartment
Figure 1

to the seat structure. When the seat is in the aft-facing position, the hooks may be engaged in brackets mounted on the floor. Thus restrained, the seat will accept a high forward G-loading.

E. Crew Toilet

A self-contained, portable unit is installed in the toilet compartment aft of the M.D.P.

2. Main Cargo Compartment

The main cargo compartment is a Class E type compartment, conforming to Civil Air Regulations, Part 4b. Vinyl encased glass fiber insulation blankets are installed throughout the pressurized area to maintain adequate thermal and acoustic insulation. The side walls and ceiling are paneled with fire-resistant removable glass fiber sheeting, opaque white in color with a high-gloss finish. The floor material is a fire-resistant treated plywood. Six flush cargo tie-down rails are set in the floor and these rails, together with a type of tie-down fitting, permit flexibility of location of cargo securing points. The tie-down fittings may be dropped through cut-outs in the rails and slid along to their required position where they are securely locked. Fixed tie-down points, in the form of lashing rings bolted to the floor structure, are provided along both sides of the compartment. The cargo tie-down rails may be used to install an approved airline type seat in compartment B.

A. Windows

The main cargo compartment windows, when installed, are located as follows:

(1) One each in the crew and rear entrance doors.

(2) One in each overwing emergency exit.

(3) One in each emergency exit door.

(4) 19 on each side of the cargo compartment.

Each window consists of two panels of craze-resistant colorless acrylic plastic. To those aircraft so fitted, an individual dessicator unit is installed for each of the windows of the four overwing emergency exits and the four emergency exit doors to prevent misting of the windows. In addition, the 38 windows of the main cargo compartment are each connected by piping to a common desiccator unit which is accessible from the forward hold.

B. Removable Partition

On aircraft so modified, a removable partition constructed of fire-resistant fabric curtain may be installed immediately aft of the forward cargo door. The partition is so designed to provide relief of pressure differential in the event of sudden decompression. When installed, the cargo compartment aft of the partition may be classified as Class E, conforming to CAR 4b.

The main cargo compartment is equipped with lighting, a smoke detector system and a ventilating system (refer to Sections 9, 10, and 7).

3. Forward and Aft Holds

The forward and aft holds are Class D compartments, conforming to Civil Air Regulations, Part 4b. Both holds have parallel vertical side walls. The space between the side walls and the fuselage shell is used for the installation of components of the aircraft systems.

Thermal insulation is provided by vinyl-encased glass fiber insulating blankets cemented to the outer skin of the aircraft. Glass fiber sheeting, similar to that used in the main cargo compartment, is used throughout both holds as trim material. Wall panels are secured with quick-release fasteners to the vertical structural members. The ceiling panels are also detachable except for those hinged panels which cover the control torque tubes and cable runs. All the detachable panels are marked with a code number to simplify installation of removed panels.

The floor of both holds is made of a sandwich fabrication of aluminum honeycomb between two sheets of aluminum alloy. Half-round nylatron rubbing strips are secured to the floor. Cargo tie-down rings, spaced at approximately every two feet, are recessed in the floor. Cargo attachment rings are located on the vertical structural members to which the wall trim panels are attached.

For a description of lighting in each hold, refer to Section 9.

4. Doors

Entrance to the aircraft is provided by a cargo door and a rear entrance door, the cargo door incorporating a crew entrance door. The entrance doors are manually operated and the cargo door is hydraulically operated and electrically controlled. Two manually operated cargo hold doors provide entrance to the forward and aft lower cargo hold areas. Internal doors are installed at the forward bulkhead.

a. Entrance Doors

The entrance doors are located on the port side of the aircraft. The crew entrance door is at the forward end of the main cargo compartment and the rear entrance door is just aft of the swing-tail break. Both doors operate in a similar manner. A recessed, centrally located, bar-type handle is pulled from its recess and turned, withdrawing the locking pins and allowing the door to be moved inward and slid along tracks, providing an unobstructed opening. Withdrawal of the pins operates a microswitch which gives warning of the unlocked condition through the master warning system. An identical handle on the exterior of the door permits opening of the door from the outside of the aircraft.

B. Cargo Hold Doors

Two inward opening cargo hold doors are provided on the starboard side of the aircraft below the floor line. A handle, similar to those on the entrance doors, is installed on the exterior side of each door. The doors, hinged at the top, open inward and are held in the open position by a latch mechanism. A microswitch installed at each door provides a warning if the door is not securely closed and locked.

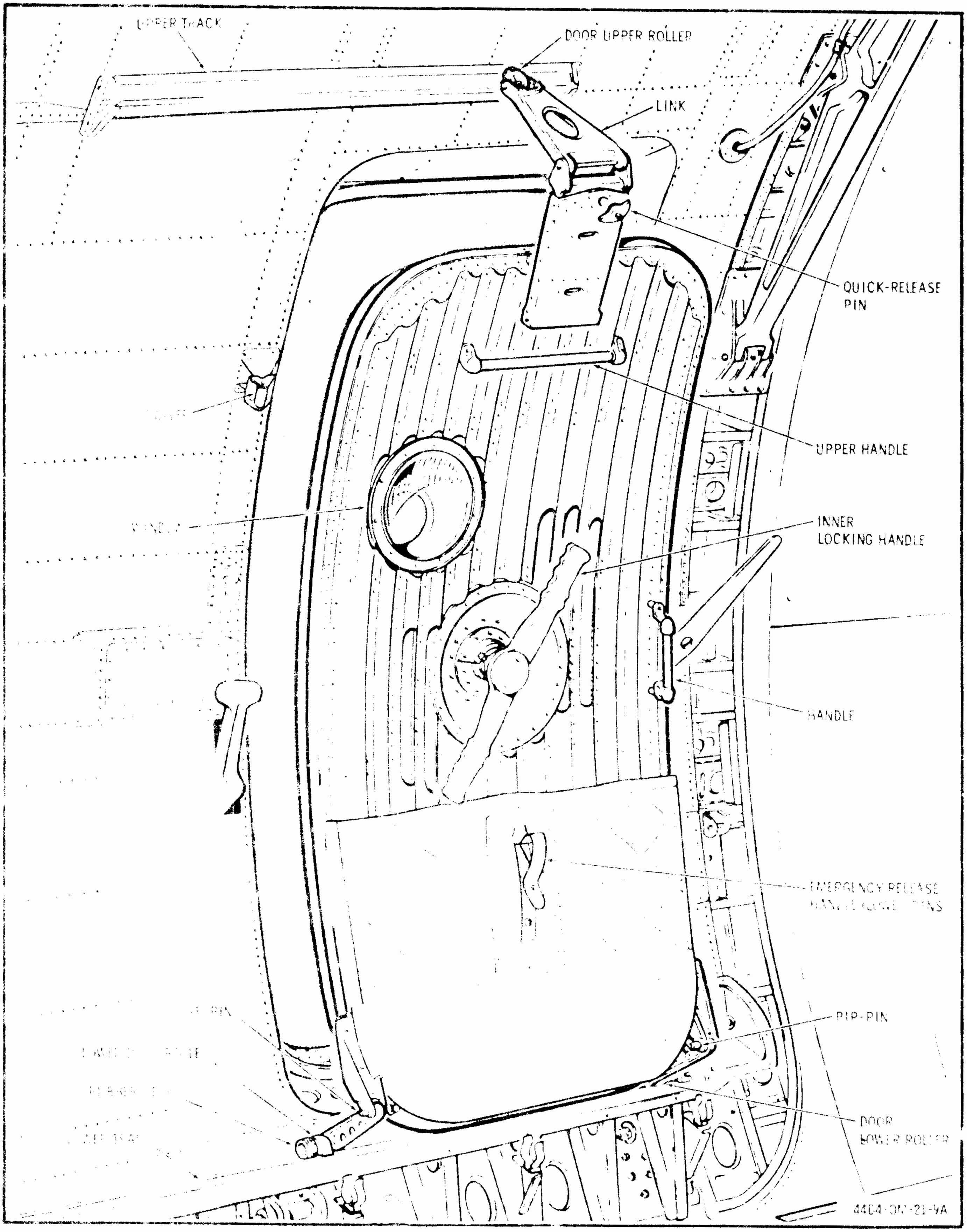
C. Cargo Door

The cargo door is hinged at the top and opens outward. Two sets of shear pins, one on each side of the door, and three hooks on the bottom, lock the door in the closed position. Hydraulic power for the operation of the door is obtained from the handpump, auxiliary hydraulic pump from the main system supply. The double-acting hydraulic actuator, when fully extended, automatically locks the door in the open position. As an added safety measure, a removable jury strut is provided to assist in holding the door open in gusting wind conditions. When the door is closed, the actuator is disconnected from its linkage and stowed, operating a microswitch which breaks the circuit to the selector valve, rendering the actuator inoperative.

To prevent damage to the forward bulkhead door by the actuator in its operating position, microswitches are installed at the door open and closed positions, one of which must be actuated before the cargo door can be operated.

The control switch for the door is located in a panel above the door. Moving the switch to either OPEN or CLOSE actuates a selector valve solenoid to correctly position the selector valve, directing fluid to either the open or close side of the actuator. Return fluid from the opposite side of the actuator is directed through the selector valve to the main system return line. The switch is spring loaded to the OFF position and, when released, disconnects power from the solenoid. The selector valve then assumes a neutral position, blocking both the pressure and return ports.

To unlock the door, two shear pin handles and three hook handles must be operated. These are interlocked so that the front set of shear pins must be withdrawn before the forward hook can be released. Similarly, the rear set of shear pins must be withdrawn before the rear hooks can be released. Each set of shear pins and each hook is provided with a microswitch which, if not actuated, will cause an unlocked condition to be indicated through the master warning system.



Crew Entrance Door
Figure 2

Air Regulations, Part 4b. Both holds have parallel vertical side walls. The space between the side walls and the fuselage shell is used for the installation of components of the aircraft systems.

Thermal insulation is provided by vinyl-encased glass fibre insulating blankets cemented to the outer skin of the aircraft. Glass fibre sheeting, similar to that used in the main cargo compartment, is used throughout both holds as trim material. Wall panels are secured with quick-release fasteners to the vertic structural members. The ceiling panels are also detachable except for those hinged panels which cover the control torque tubes and cable runs. All the detachable panels are marked with a code number to simplify installation of removed panels.

The floor of both holds is made of a sandwich fabrication of aluminum honeycomb between two sheets of aluminum alloy. Half-round nylatron rubbing strips are secured to the floor. Cargo tie-down rings, spaced at approximately every two feet, are recessed in the floor. Cargo attachment rings are located on the vertical structural members to which the wall trim panels are attached.

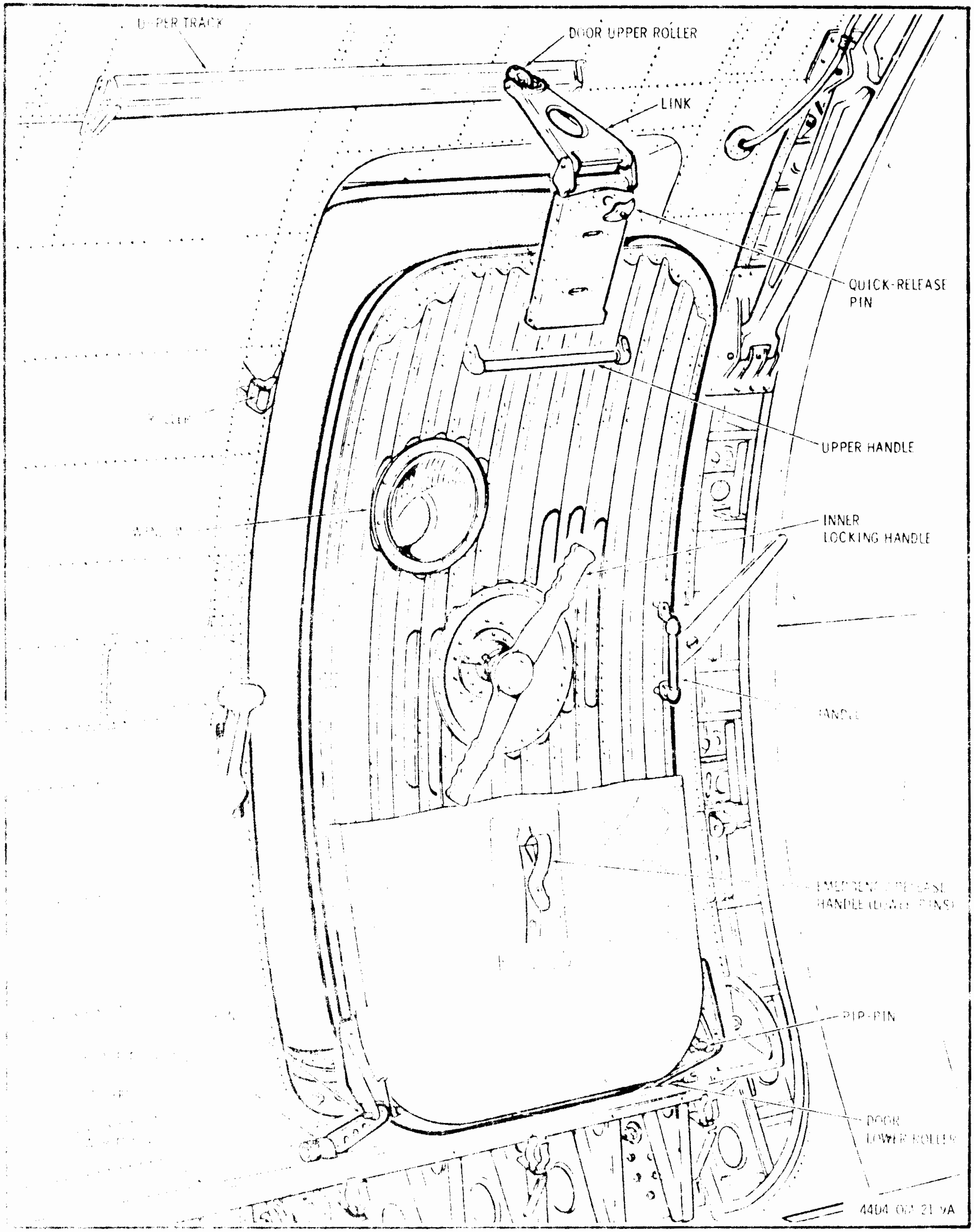
For a description of lighting in each hold, refer to Section 9.

4. Doors

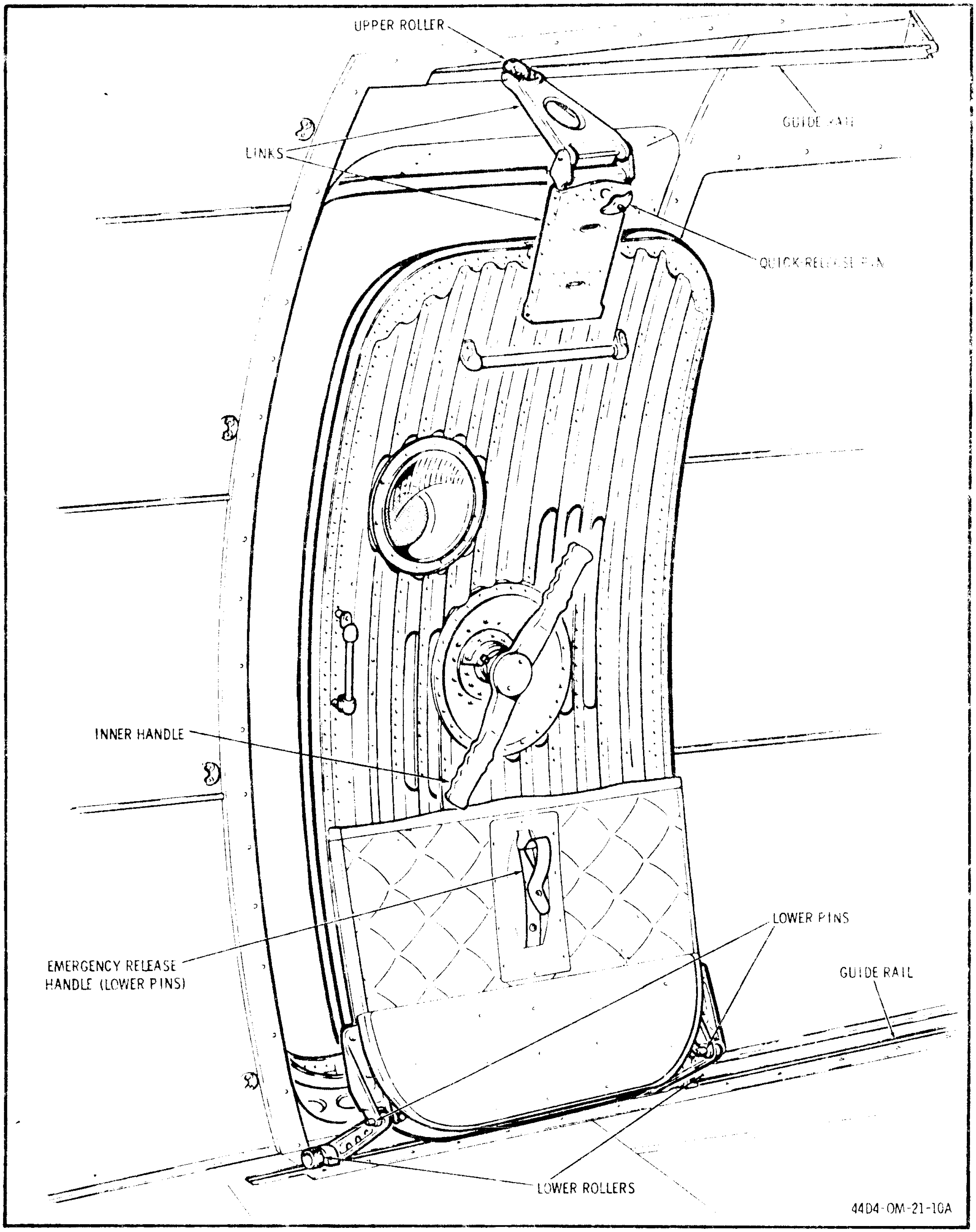
Entrance to the aircraft is provided by a cargo door and a rear entrance door, the cargo door incorporating a crew entrance door. The entrance doors are manually operated and the cargo door is hydraulically operated and electrically controlled. Two manually operated cargo hold doors provide entrance to the forward and aft lower cargo hold areas. Internal doors are installed at the forward bulkhead and the washroom.

A. Entrance Doors (Ref. Figs. 2 and 3)

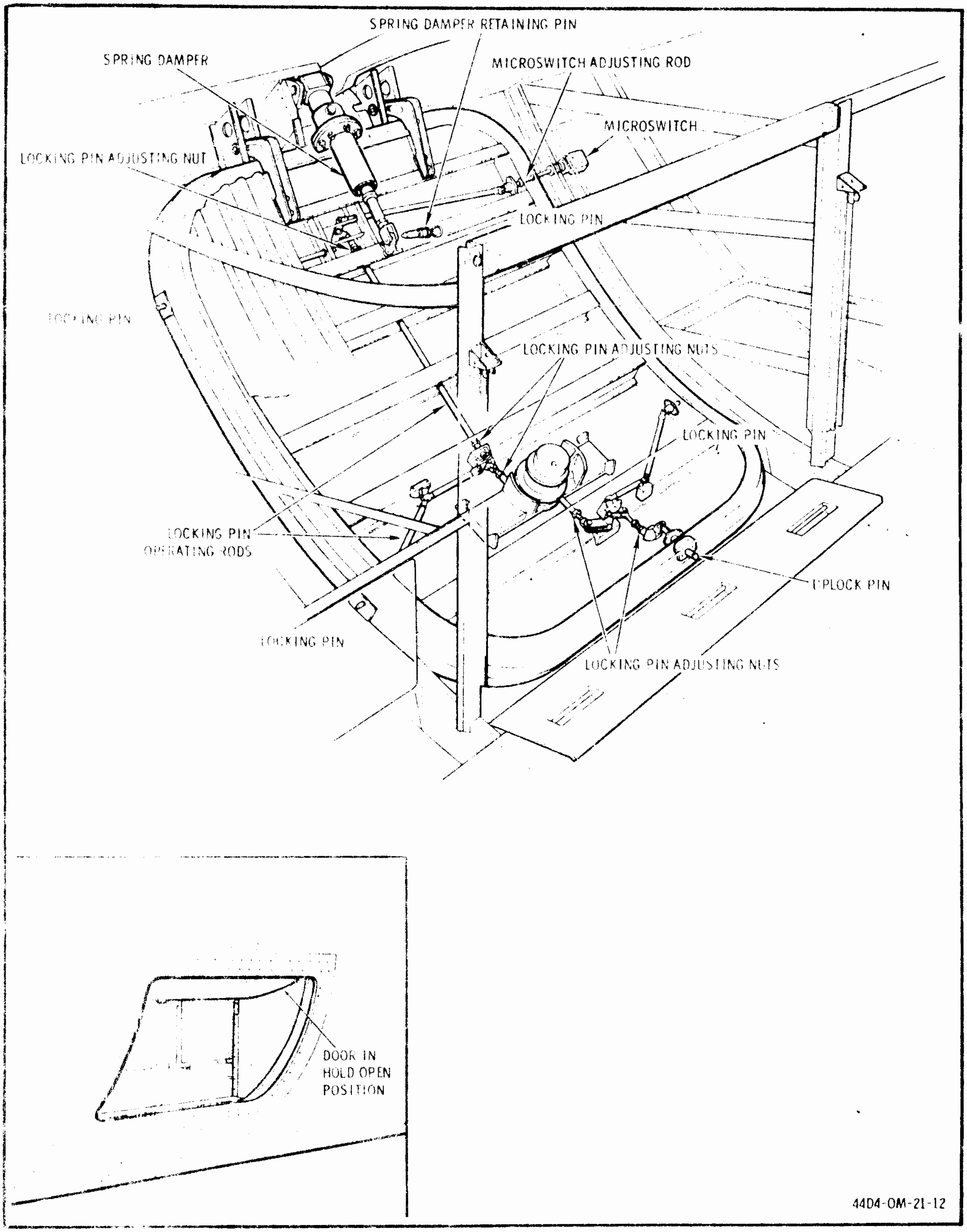
The entrance doors are located on the port side of the aircraft. The crew entrance door is at the forward end of the main cargo compartment and the rear entrance door is just aft of the swing-tail break. Both doors operate in a similar manner. A recessed, centrally located, bar-type handle is pulled from its recess and turned, withdrawing the locking pins and allowing the door to be moved inward and slid along tracks, providing an unobstructed opening. Withdrawal of the pins operates a microswitch which gives warning of the unlocked condition through the master warning system. An identical handle on the exterior of the door permits opening of the door from the outside of the aircraft.



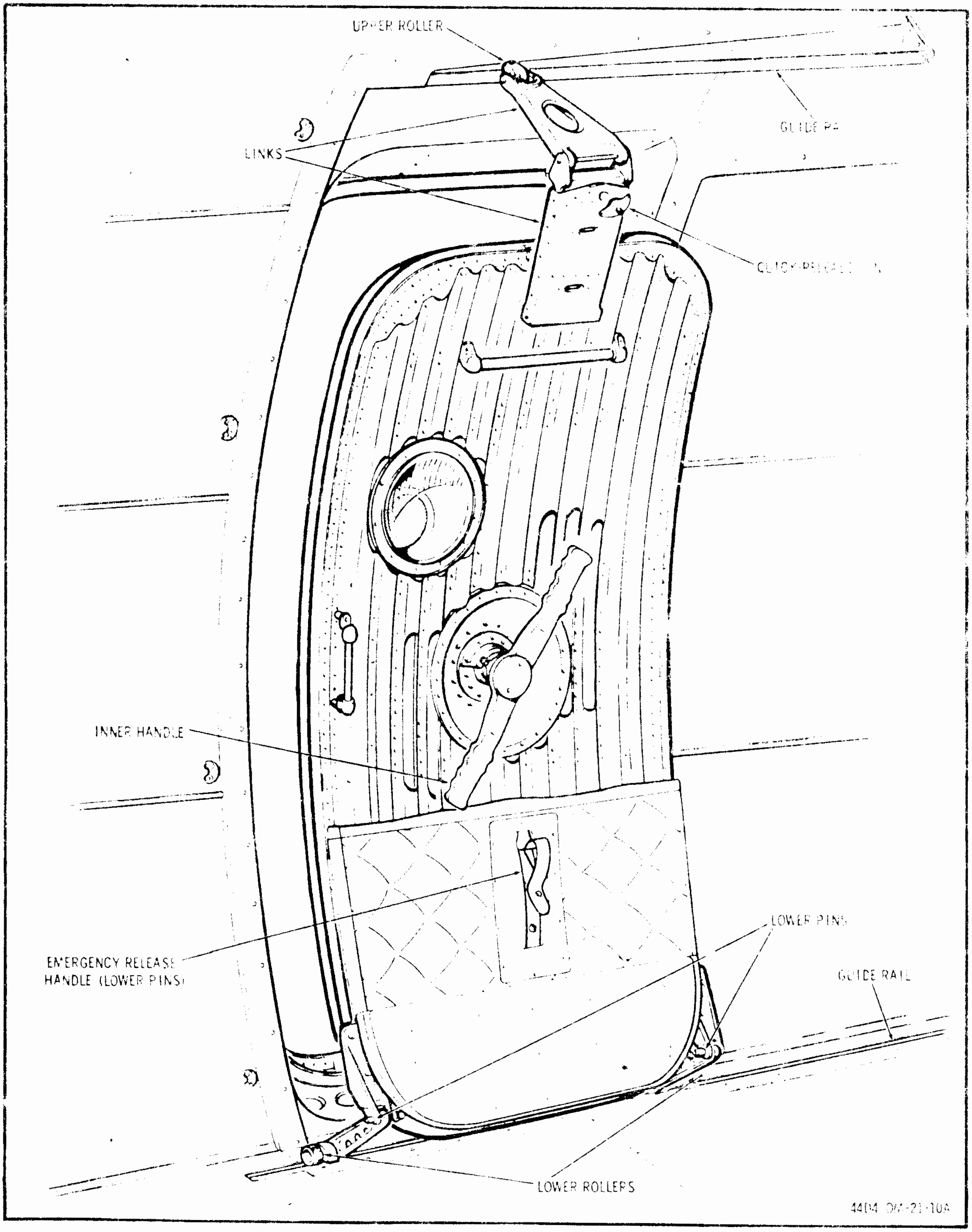
Crew Entrance Door
Figure 2

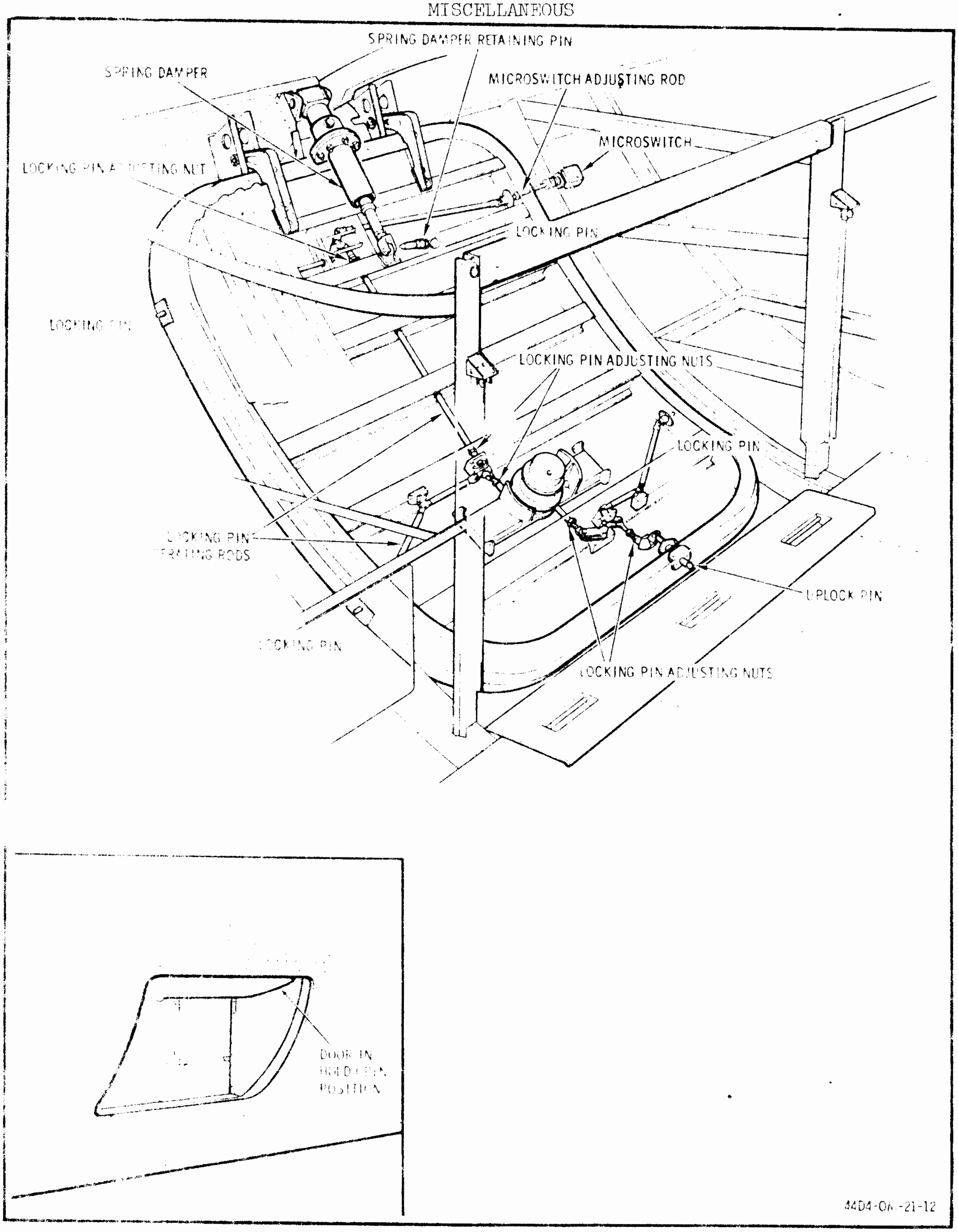


Rear Entrance Door
Figure 3


SPRING DAMPER RETAINING PIN
SPRING DAMPER
MICROSWITCH ADJUSTING ROD
MICROSWITCH
LOCKING PIN ADJUSTING NUT
LOCKING PIN
LOCKING PIN
LOCKING PIN ADJUSTING NUTS
LOCKING PIN
LOCKING PIN OPERATING RODS
UPLOCK PIN
LOCKING PIN
LOCKING PIN ADJUSTING NUTS
DOOR IN HOLD OPEN POSITION
44D4-OM-21-12

Forward and Aft Hold Doors
Figure 4


UPPER ROLLER
GUIDE RAIL
LINKS
QUICK-RELEASE PINS
INNER HANDLE
EMERGENCY RELEASE HANDLE (LOWER PINS)
LOWER PINS
GUIDE RAIL
LOWER ROLLERS
4404 OM-21-10A


SPRING DAMPER RETAINING PIN
SPRING DAMPER
MICROSWITCH ADJUSTING ROD
MICROSWITCH
LOCKING PIN ADJUSTING NUT
LOCKING PIN
LOCKING PIN
LOCKING PIN ADJUSTING NUTS
LOCKING PIN
LOCKING PIN OPERATING RODS
UPLOCK PIN
LOCKING PIN
LOCKING PIN ADJUSTING NUTS
DOOR IN HOLD OPEN POSITION
44D4-OA-21-12

B. Cargo Hold Doors (Ref. Fig. 4)

Two inward opening cargo hold doors are provided on the starboard side of the aircraft below the floor line. A handle, similar to those on the entrance doors, is installed on the exterior side of each door. The doors, hinged at the top, open inward and are held in the open position by a latch mechanism. A microswitch installed at each door provides warning if the door is not securely closed and locked.

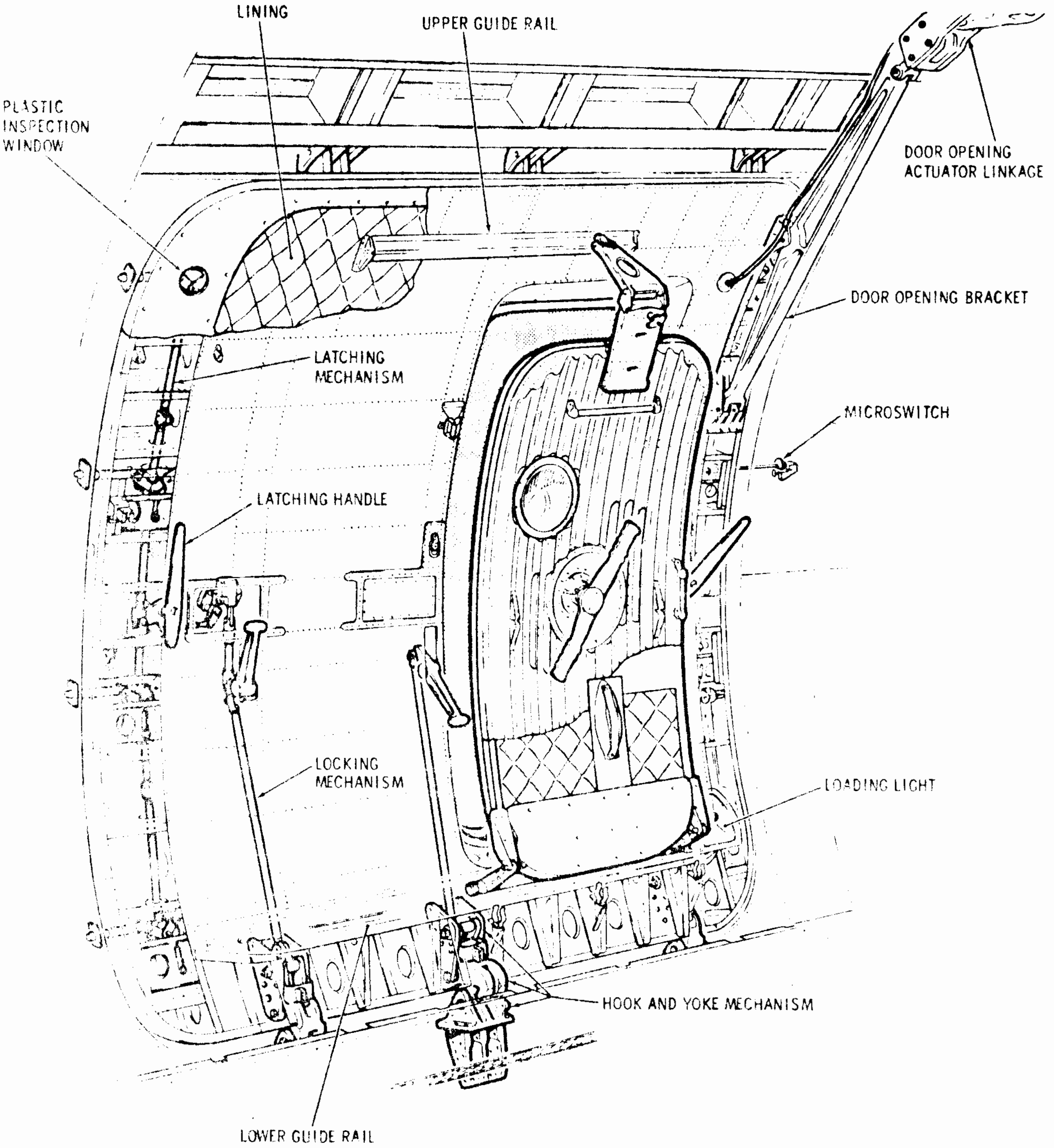
C. Cargo Door (Ref. Fig. 5)

The cargo door is hinged at the top and opens outward. Two sets of shear pins, one on each side of the door, and three hooks on the bottom, lock the door in the closed position. Hydraulic power for the operation of the door is obtained from the handpump, auxiliary hydraulic pump or main system supply. The double-acting hydraulic actuator, when fully extended, automatically locks the door in the open position. As an added safety measure, a removable jury strut is provided to assist in holding the door open in gusting wind conditions. When the door is closed, the actuator is disconnected from its linkage and stowed, operating a microswitch which breaks the circuit to the selector valve, rendering the actuator inoperative.

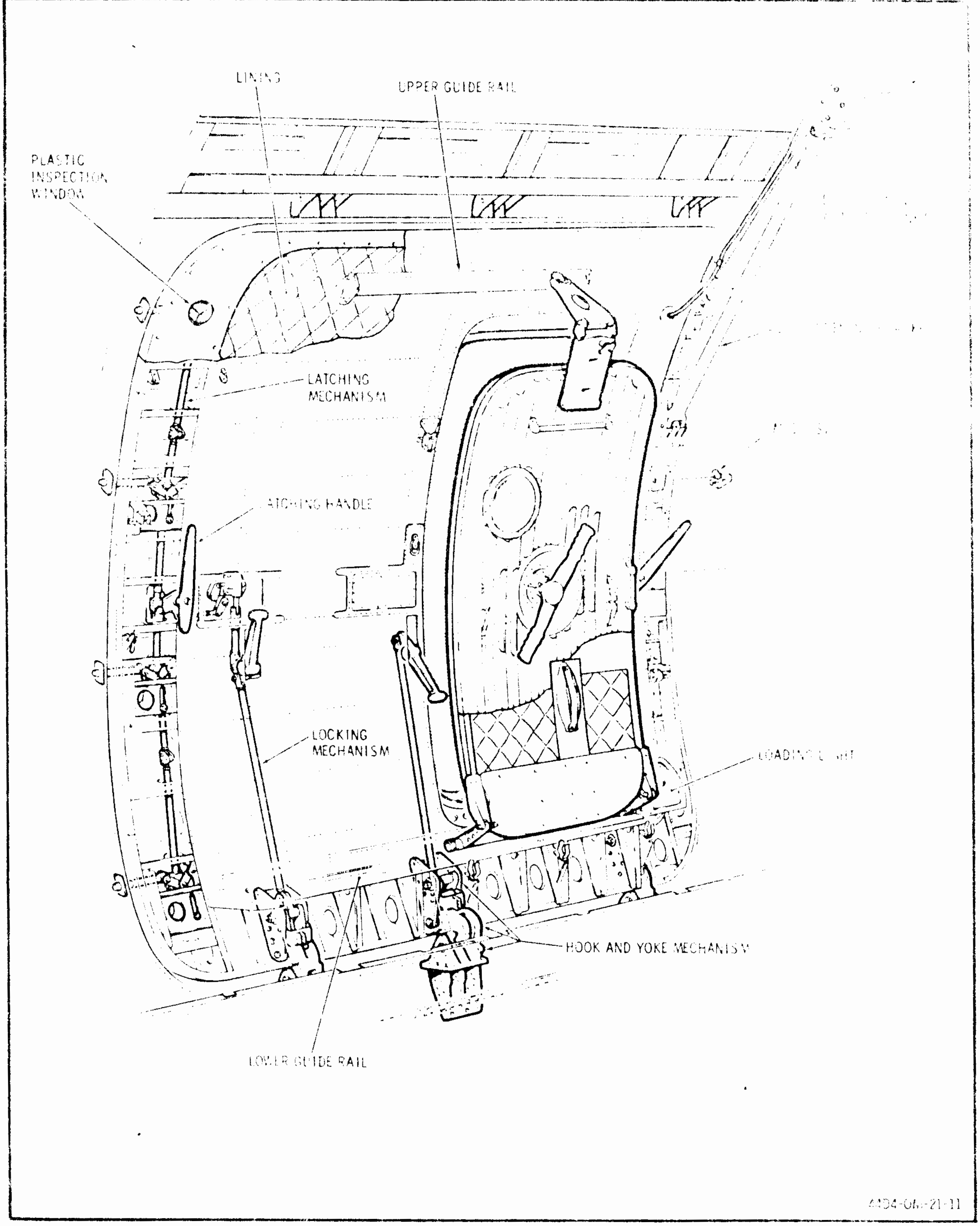
To prevent damage to the forward bulkhead door by the actuator in its operating position, microswitches are installed at the door open and closed positions, one of which must be actuated before the cargo door can be operated.

The control switch for the door is located in a panel above the door. Moving the switch to either OPEN or CLOSE actuates a selector valve solenoid to correctly position the selector valve, directing fluid to either the open or close side of the actuator. Return fluid from the opposite side of the actuator is directed through the selector valve to the main system return line. The switch is spring loaded to the OFF position and, when released, disconnects power from the solenoid. The selector valve then assumes a neutral position, blocking both the pressure and return ports.

To unlock the door, two shear pin handles and three hook handles must be operated. These are interlocked so that the front set of shear pins must be withdrawn before the forward hook can be released. Similarly the rear set of shear pins must be withdrawn before the rear hooks can be released. Each set of shear pins and each hook is provided with a microswitch which, if not actuated, will cause an unlocked condition to be indicated through the master warning system except on LL aircraft where the cargo door is not used.



Cargo Door
Figure 5


LINING
UPPER GUIDE RAIL
PLASTIC INSPECTION WINDOW
LATCHING MECHANISM
LATCHING HANDLE
LOCKING MECHANISM
LOADING LIGHT
HOOK AND YOKE MECHANISM
LOWER GUIDE RAIL
44D4-06-21-11

Cargo Door

D. Internal Doors

The door between the cargo compartment and the flight compartment is semi-rigid, hinged at the starboard side and swings 180° into the cargo compartment. A lock is installed which is latched on the inside and a key locks and unlocks it from the cargo compartment side.

A second hinge is installed down the center of the door and the two halves are held rigid by two linkage mechanisms which are locked by shear pins. In the case of sudden decompression, the pins are sheared and the door can fold either forward into the flight compartment or rearward into the cargo compartment. The bottom panel of the door is of rigid construction and when the center hinge is utilized this panel is released, allowing the door to be folded forward without interference from the astro platform.

In an emergency, the door can be opened into the crew compartment by operating two locking handles on forward side of door. This action releases linkage mechanism and the door can then be folded on the center hinge.

Two microswitches are recessed in the bulkhead on which the door is hung. One is actuated when the door is latched shut, the other when it is fully open against the bulkhead. The microswitches control a safety circuit which prevents operation of the cargo door when the door is in an intermediate position, where it could be damaged by the actuation mechanism.

A forward-folding two-panel door provides access to the washroom. It opens into the aisle behind the navigators seat.

5. Water and Waste Systems

A. Water System

Water for drinking and washing purposes is supplied by a 4½ gallon carry-on container mounted on a shelf on the aft side of the toiler rear bulkhead. A webbing strap secures the container when it is fitted in the aircraft.

6. Emergency Exits

The emergency exits for all D4 aircraft are the crew ditching hatch and the two overwing escape exits. In addition, the crew and rear entrance doors are designed to be opened from both inside and outside of the aircraft and, in an emergency, can be removed from their hinges from inside of the aircraft. On aircraft so modified, additional emergency exits are provided: one starboard forward emergency exit, two starboard rear emergency exits, and the port rear emergency exit.

D. Internal Doors

The door between the cargo compartment and the flight compartment is semi-rigid, hinged at the starboard side and swings 180° into the cargo compartment. A lock is installed which is latched on the inside and a key locks and unlocks it from the cargo compartment side.

A second hinge is installed down the centre of the door and the two halves are held rigid by two linkage mechanisms which are locked by shear pins. In the case of sudden decompression, the pins are sheared and the door can fold either forward into the flight compartment or rearward into the cargo compartment. The bottom panel of the door is of rigid construction and when the centre hinge is utilized this panel is released, allowing the door to be folded forward without interference from the astro platform.

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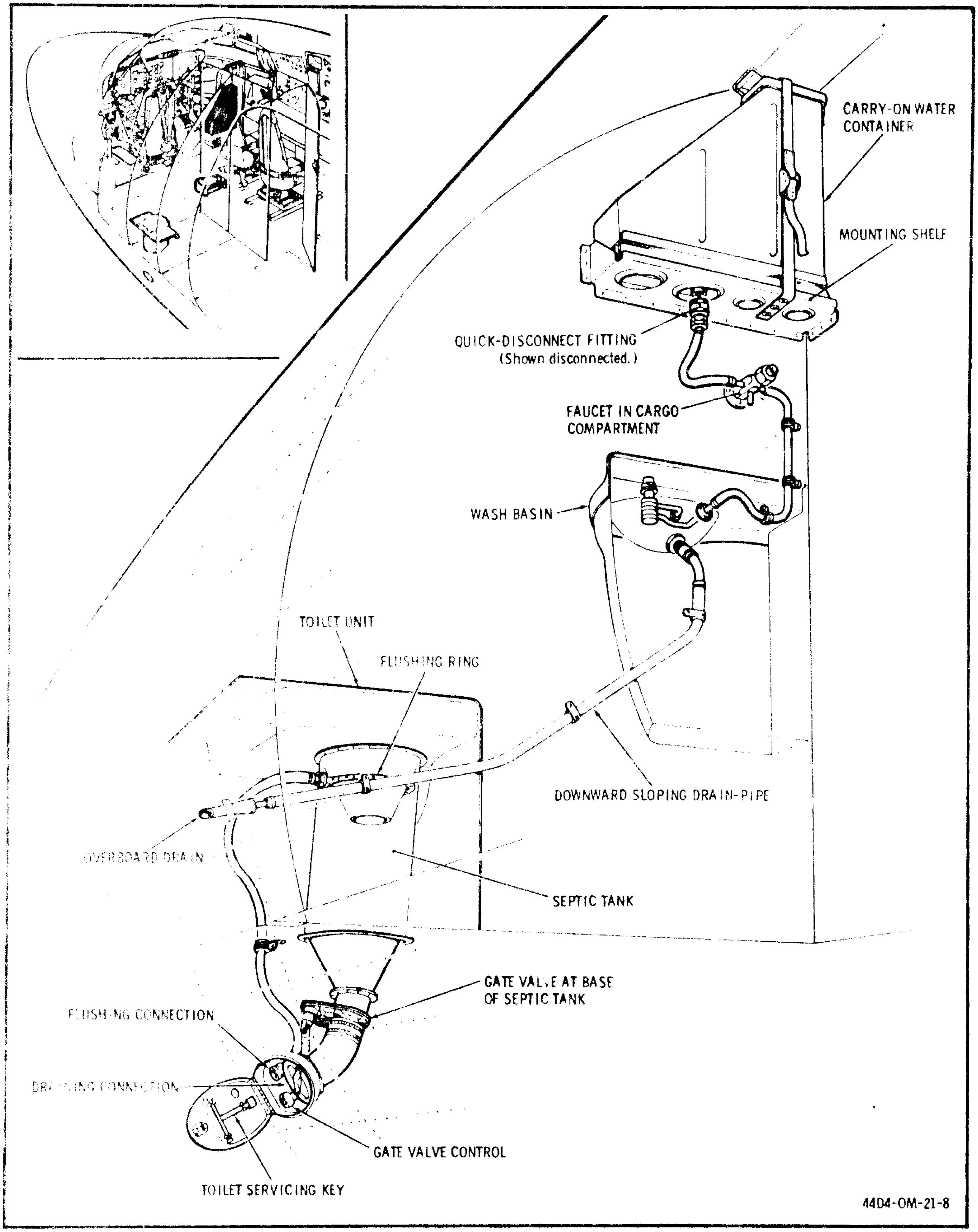
A forward-folding two-panel door provides access to the washroom. It opens into the aisle behind the navigators seat.

5. Water and Waste Systems

A. Water System (Ref. Fig. 6)

Water for drinking and washing purposes is supplied by a 4-1/2 gallon carry-on container mounted on a shelf on the aft side of the toilet rear bulkhead. A webbing strap secures the container when it is fitted in the aircraft. A special fitting on the base of the container mates with a connection on the mounting shelf to permit water flow. A plastic pipe connected to the mounting shelf connection serves two faucets, one at the toilet washbasin and one on the aft side of the toilet rear bulkhead. The second faucet will be used to serve a galley unit if installed. Both faucets are spring loaded to the off position. The system is unpressurized and flow is by gravity.

Waste water from the toilet wash basin is fed to an external drain point on the fuselage skin forward of the lower edge of the main cargo door. When the sink drain plug, which is spring loaded to the closed position, is raised, water in the basin will drain out by gravity assisted, when the



Water and Waste Systems
Figure 6

A. Crew Ditching Hatch

The crew ditching hatch is located in the roof of the flight compartment. It is elliptical in shape and is hinged on the aft side. To open, the central handle is turned counter-clockwise, freeing the locking pins at the sides of the hatch and allowing the hatch to be swung downwards. When open, the hatch can be lifted off its hinges. Entrance can be gained from outside by pressing the button, lifting and turning handle.

B. Overwing Escape Hatches

The overwing escape hatches are situated in the main cargo compartment, two on each side of the fuselage above the main wings. Operation from inside the aircraft is achieved by pulling a handle at the top of the hatch which unlocks the frame, permitting the exit to be swung downwards. The exit can then be lifted off its hinges and removed. Entrance can be gained from the outside by depressing a push button at the top of the hatch. The button duplicates the function of the inside handle and allows the hatch to be pushed inwards.

C. Crew and Rear Entrance Doors

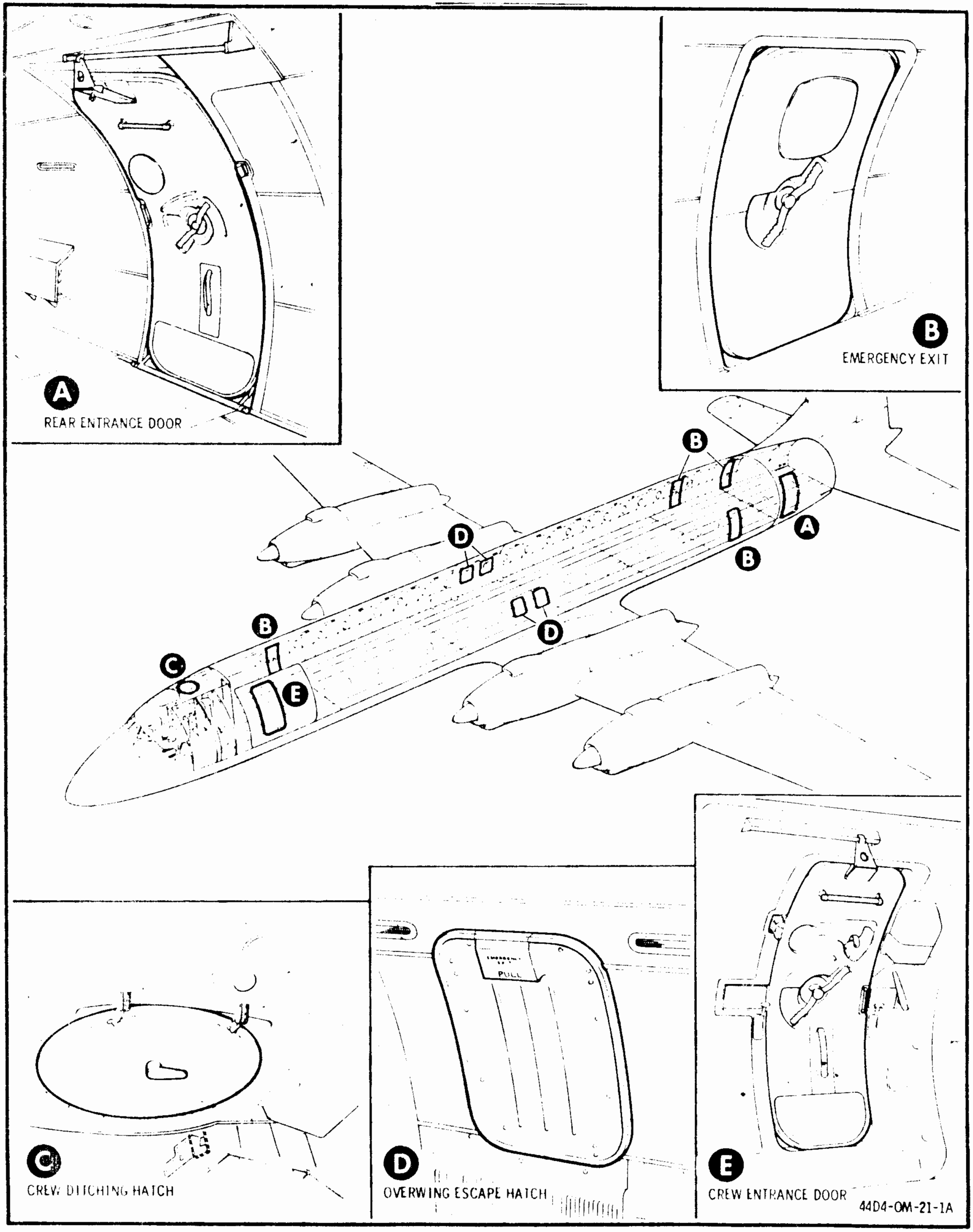
The crew and rear entrance doors each have a recessed bar-type operating handle on each side of the door. To open the door, the bar handle is pulled out and rotated. This action withdraws the locking pins and allows the door to be moved inwards on its hinges and be slid aside. In an emergency, the crew and rear entrance doors can be completely removed by the following actions: the bar handle is pulled out and turned to withdraw the locking pins. A pip-pin in the center of the small handle on the top sliding hinge is depressed allowing the handle to be pulled. Pulling the top hinge handle will withdraw the quick-release top hinge pin and permit the door to be swung inwards and downwards. A handle on the center-line of the door below the bar handle is then lifted up, withdrawing the two lower hinge pins and permitting the door to be removed.

D. Emergency Door Exits

The four emergency door exits are similar in construction and operation. Each door has a recessed bar-type operating handle on each side of the door. Pulling out and rotating the door handle will withdraw the door locking pins. The door is then removed inwards.

7. Emergency Equipment (For procedures on use of emergency equipment, see Volume I, Section 6 of General Company Policies.)

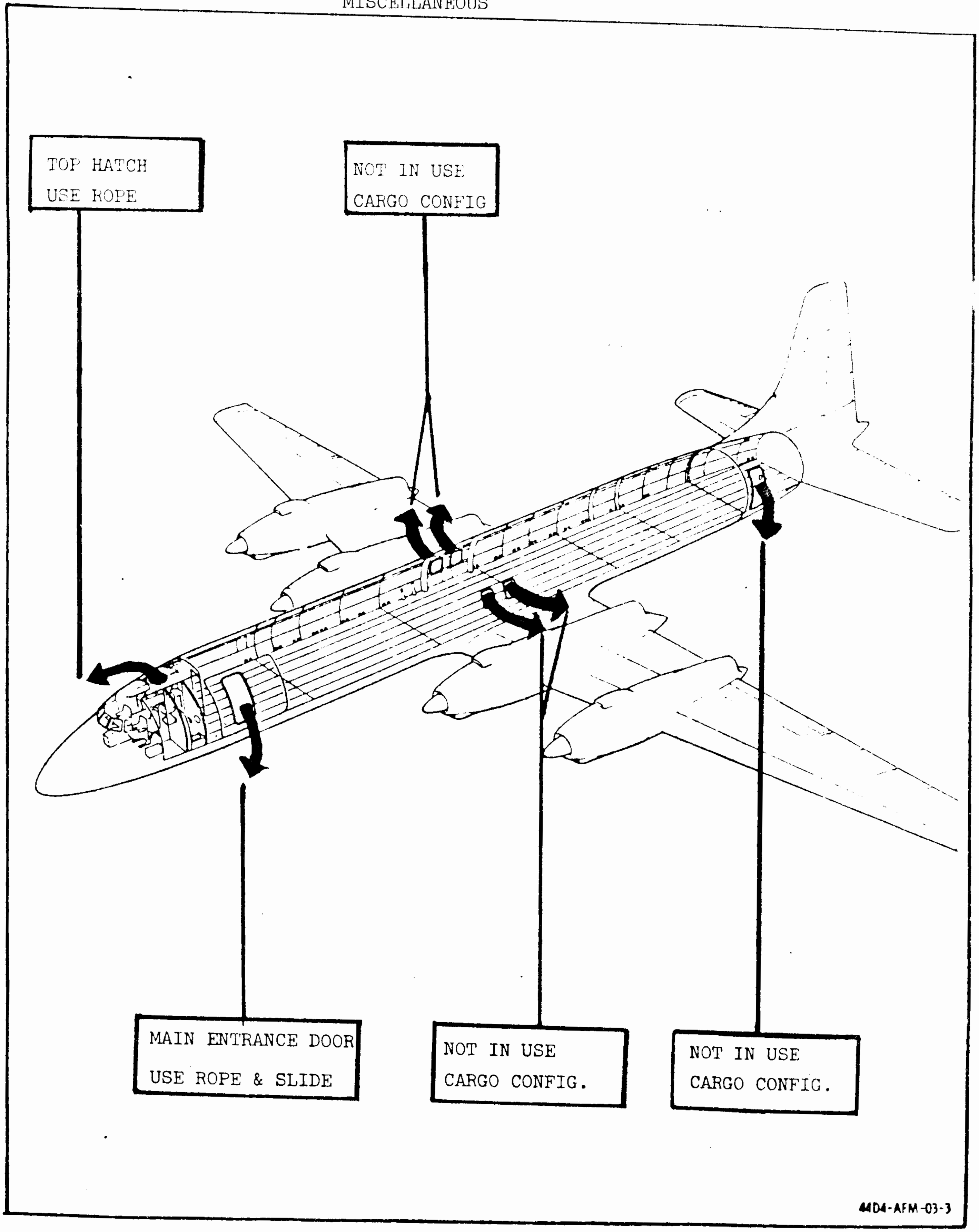
The various items of emergency equipment are strategically located within the aircraft to be readily available in time of need. The emergency equipment caters for in-flight casualty/first aid action, for immediate escape from the aircraft after it lands or ditches, and for survival subsequent to


A
REAR ENTRANCE DOOR
B
EMERGENCY EXIT
B
B
A
D
B
C
E
D
C
CREW DITCHING HATCH
PULL
D
OVERWING ESCAPE HATCH
E
CREW ENTRANCE DOOR
44D4-OM-21-1A

aircraft is pressurized, by a positive cabin-to-ambient pressure. An electrically operated and controlled heater prevents ice formation at the discharge outlet (refer to Section 13).

B. Toilet Waste Disposal

Toilet waste matter is retained on board the aircraft during flight in a


TOP HATCH
USE ROPE
NOT IN USE
CARGO CONFIG
MAIN ENTRANCE DOOR
USE ROPE & SLIDE
NOT IN USE
CARGO CONFIG.
NOT IN USE
CARGO CONFIG.
44D4-AFM-03-3

MISCELLANEOUS

landing. Portable fire extinguishers and emergency oxygen equipment are dealt with in other sections of this manual (refer to Sections 10 and 16).

A. First Aid Kit

A general purpose first aid kit is stowed on the forward bulkhead in the crew toilet.

B. Axes and Crowbar

A 24 inch goose-necked crowbar and a USAF-type hand axe and scabbard are mounted on the rear face of the raised portion of the flight compartment floor behind the pilots seat.

C. Escape Ropes

A nylon escape rope, 7/16 inch in diameter and approximately 20 feet long, is stowed adjacent to the ditching hatch in the flight compartment. The rope is knotted along its length and one end is anchored to the aircraft structure. The rope is coiled within a hinged drop-down stowage box which is held in the closed position by two winged-head quick-release fasteners. A second escape rope is stowed in a stowage box mounted forward of the crew entrance door.

D. Lifejackets (KS-9.TSO C 18C/ATA 801.)

A lifejacket stowage is provided at the rear of each crew members seat. The pilots and co-pilots stowages are mounted vertically and the systems operators and navigators horizontally. The stowage is a tubular shaped, Versalite container with press studs at each end to permit quick access to the lifejacket inside. The word LIFEJACKET is clearly marked on the outside of the container.

E. Flare Chutes (Flare Removed)

Two vertically mounted chutes for Wiley Type SA 8 parachute flares are installed in the unpressurized tail cone area. Each flare is released by the actuation of a related switch on the pilots overhead panel. The two landing flare chute switches are identified as LH and RH and the switch positions are marked CLOSED and OPEN. Placing a switch to OPEN will energize the related solenoid-operated release unit, located adjacent to the chute, which releases the door from its latched position. When the door becomes unlatched, the weight of the flare within the chute, assisted initially by the compression of a spring above the flare, forces the door open. A lanyard attached to the flare and to a clip at the entrance of the flare chute causes the flare to ignite after it has fallen a safe distance from the aircraft.

When the switch is restored to the CLOSED position, the door latching mechanism returns to its previous position. However, the door cannot be closed in flight. To close the door on the ground, it must be pushed up manually until it engages the latch.

F. Dinghies

One six-man dinghy is carried in a valise pack stowed on the aft side of the flight compartment.

The dinghy pack contains the following equipment:

- Water Activated Light
- Shark Repellant
- Floating Knife
- CO_2 Inflation
- Hand Pump
- Bailing Bucket
- Retaining Line
- Sea Anchor
- Instruction Sheet
- Flashlight
- Signal Mirror
- Police Whistle
- Dye Marker
- Canopy and Mast
- Canopy Rods
- Utility Knife
- Oars
- Flare Kit
- Repair Kit
- Fishing Kit
- Canned Water
- Can Opener
- Ration Kit
- Compass
- Survival Manual
- Water Bag/Cups
- Emergency Locator Transmitter

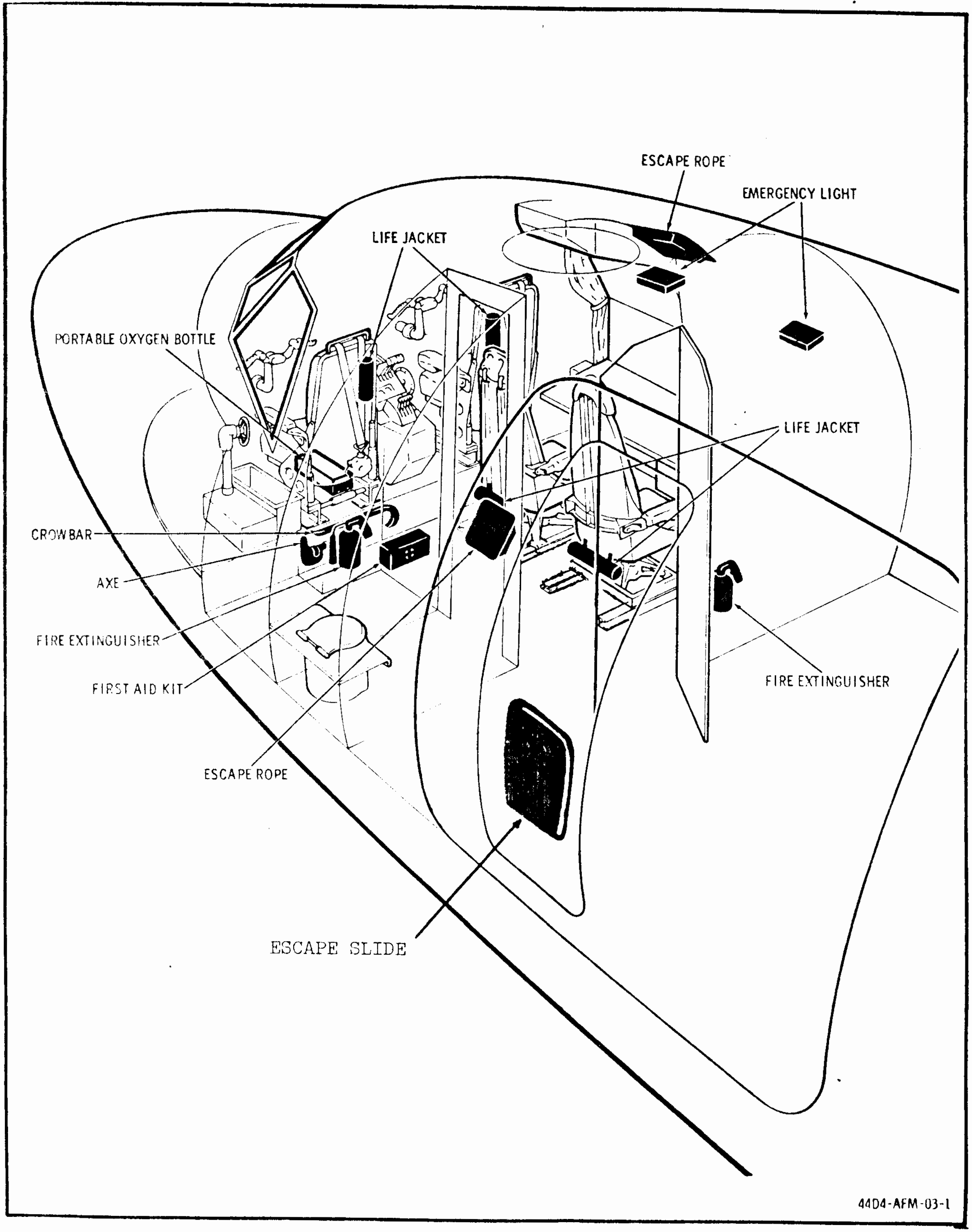
8. Emergency Lighting

A. Dinghy Lights

Two dinghy lights are mounted in the outer fuselage skin to provide illumination of the inboard trailing edges of the wings. Each light is energized through an integral inertia switch and independently powered by a 6-volt nickel-cadmium battery located in the forward hold. Remote control of both lights is also provided by a toggle switch located at the crew ditching hatch. The toggle switch will by-pass the inertia switch. A manual reset button on the light assembly may be used to turn the light off after the inertia switch only has been operated.

B. Portable Emergency Lights

Two portable emergency lights are provided, stowed in the roof of the aircraft at the navigators station and in line with the forward cargo door. Each light is powered by an integral nickel-cadmium battery which, when fully charged, will operate the light for a minimum period of 15 minutes. Each light can be operated either manually by a toggle switch on the light assembly or by an integral inertia switch. After inertia operation, the inertia switch can be reset and the light extinguished by a manual reset knob. A test switch is provided to facilitate circuit test function. The whole assembly can be detached from the stowage mounting by depressing the release spring and pulling the light carrying handle.


ESCAPE ROPE
EMERGENCY LIGHT
LIFE JACKET
PORTABLE OXYGEN BOTTLE
LIFE JACKET
CROWBAR
AXE
FIRE EXTINGUISHER
FIRST AID KIT
FIRE EXTINGUISHER
ESCAPE ROPE
ESCAPE SLIDE
44D4-AFM-03-1

9. Interior Arrangement

A. Removable Partition

Fittings are provided for the installation of a removable partition at five different positions in the main cabin. The partition is constructed of fire-resistant fabric and, when installed, the area forward of the partition is considered a Class B cargo compartment.

B. Ordinance Signs

Power outlets are provided adjacent to each of the removable partition fittings for the installation of a FASTEN SEAT BELT sign and a NO SMOKING sign. A RETURN TO SEAT sign is installed in each washroom. A switch on the pilots overhead panel operates the signs.

C. Lighting

Dome lights, installed in each of the washrooms, are controlled by a switch on the attendants control panel. The cabin dome lights are controlled by a changeover switch and an ON/OFF switch both located on the swing-tail control panel, and an ON/OFF switch on the attendants control panel. The changeover switch, marked ATTENDANT/LOCAL, permits control of the cabin dome lights from either station. A portable emergency light is located in the roof of the main compartment between the rear entrance door and the rear right hand emergency exit, between the right and left hand emergency exits forward of the swing-tail break, between the right and left hand overwing escape hatches, and adjacent to the forward right hand emergency exit. The lights may be manually operated or are energized by inertia switches.

D. Escape Chutes

One escape chute is provided as emergency equipment and attachment fittings are installed on the forward entrance door.

10. Internal Cargo Loading Equipment

A. Main Cargo Compartment Nets

Five types of nets are used in the main cargo compartment:

(1) Ten pallet overthrow nets - one per pallet.

(2) Nine inter-pallet barrier nets - separate the pallets.

(3) One forward transverse barrier net - installed immediately aft of the forward cargo door in front of the first pallet.

(4) One forward compartment barrier and overthrow net - restrains loose cargo stowed forward of the first pallet.

(5) One swing-tail separator net - restrains loose cargo stowed in the swing-tail compartment.

All nets are similar in construction. Vertical and horizontal webbing straps of nylon or Dacron are used. The straps are sewn together at their intersections. Except for the pallet overthrow nets which are secured directly to the pallets, all nets are attached to the aircraft structure. The bottom ends of the vertical straps have removable floor fittings which fit in the floor rails. The method of attaching the upper end of the vertical straps and the horizontal straps varies with the type of net.

B. Pallet Overthrow Nets

The overthrow net is fitted when the pallet is loaded at the terminal building. The net is secured to the D-rings at the side of the pallet in sufficient tension to restrain the cargo. After the sides of the net are secured, netting panels at the front and rear are fastened together.

C. Inter-pallet Barrier Nets

A maximum of nine inter-pallet barrier nets are used. One is installed at the aft limit of each of the forward eight cargo compartments. The ninth is installed at the tenth compartment. It is adequate for both ninth and tenth compartments. When the tenth compartment is not loaded, net No. 9 is moved forward to terminate the ninth compartment. The nets are secured by floor fittings and hooks which engage with rings around the periphery of the fuselage. The rings are carried on twelve cable assemblies running the length of the fuselage from aft of the forward cargo door to the swing-tail break. Adjustment fittings are provided on each cable assembly to maintain tension.

D. Forward Transverse Barrier Net

The forward transverse barrier net is semi-permanently installed in the aircraft. The net is attached to the fuselage by six removable floor fittings and twelve fittings around the periphery of the fuselage. To enable personnel to walk past the installed net, two horizontal straps are quickly detachable.

E. Forward Compartment Barrier and Overthrow Net

Loose bulk cargo that is loaded through the forward cargo door is stowed in front of the first pallet. The net for this area consists of two elements. A transverse barrier net ahead of the load is secured to the structure by fittings in the floor rails and by cables to strong points around the periphery of the fuselage. An overthrow net is attached to the floor and sidewall on the starboard side and to the floor rail on the port side. Adjustable buckles on the webbing straps and a selection of rings on the cables provide for adjustment to different size loads.

F. Swing-Tail Separator Net

The swing-tail separator net is fitted in the swing-tail portion to restrain the cargo stowed there. Page 20 shows the position of the net when installed. The net is secured to the floor by the floor fittings, the side and upper attachments connecting with anchor fittings to the walls and ceiling. When the net is in position, access is provided from the rear entrance door to the swing-tail control panel on the opposite side of the fuselage.

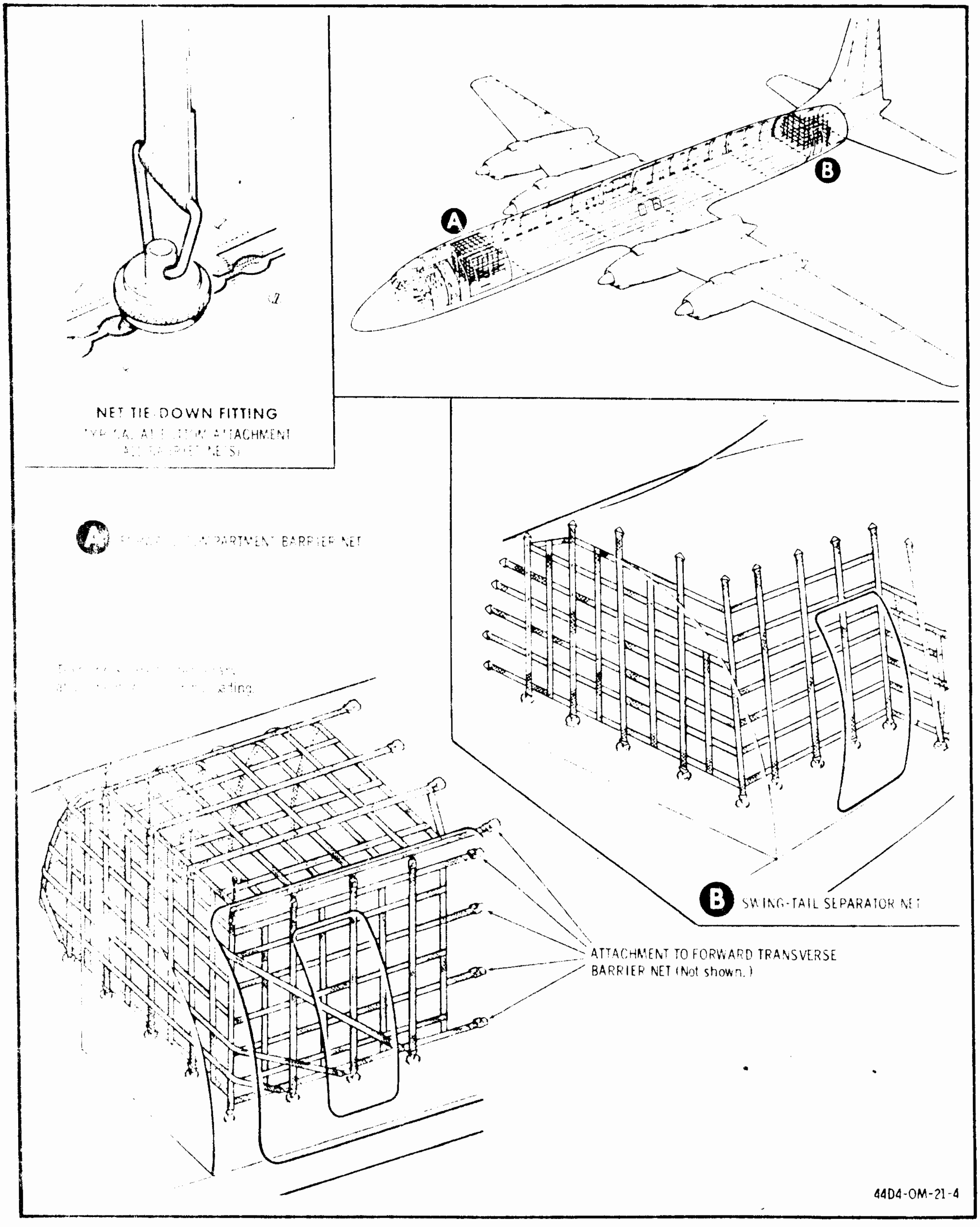
G. Underfloor Barrier Nets

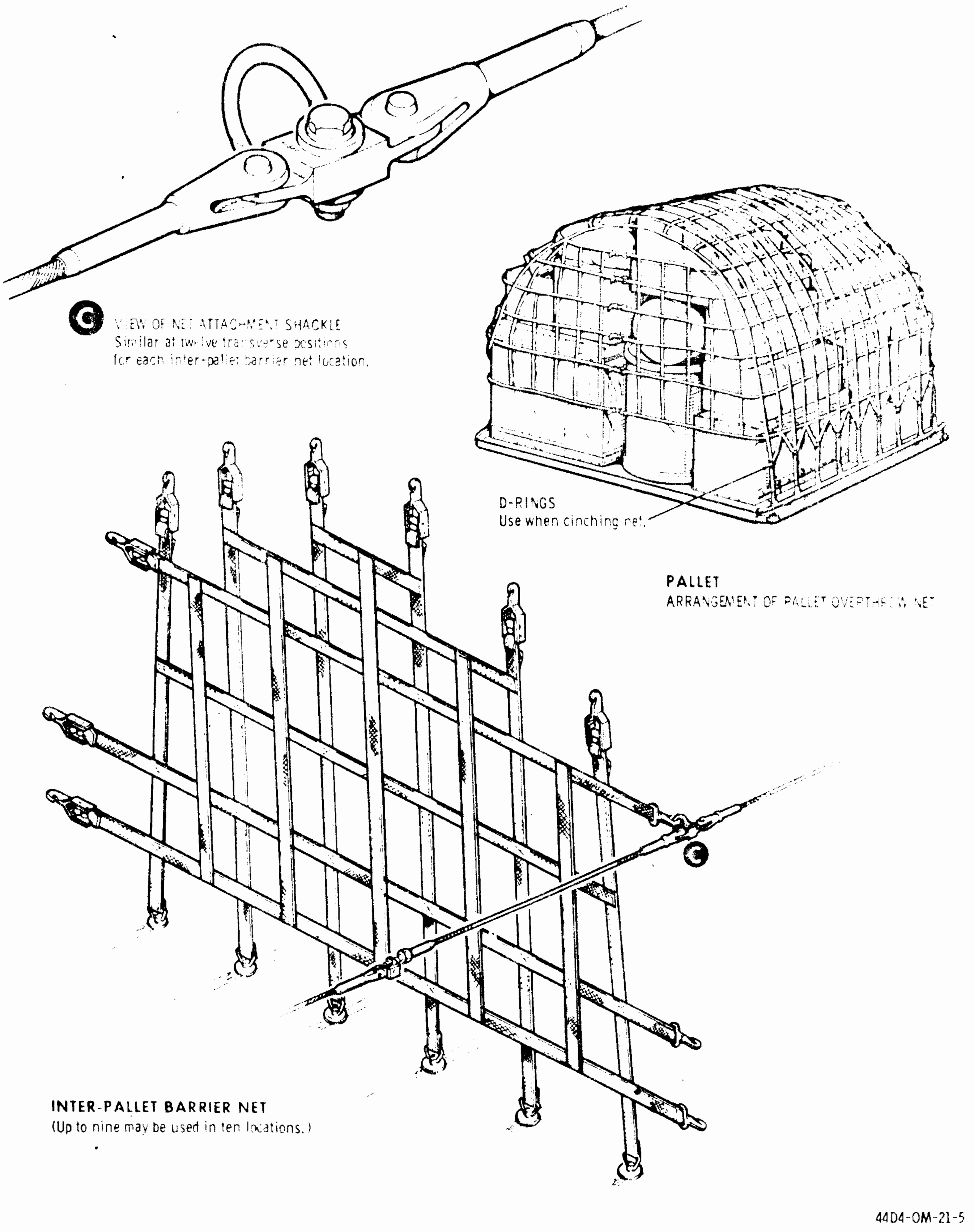
A barrier is fitted at each hold door to prevent cargo from blocking the inward-opening door. The barrier consists of two side panels connected by a barrier assembly across the door opening. Each side panel consists of an inclined support tube, spring-loaded for ease of removal, which fits into sockets on the hold floor and ceiling structure. The inclined tube supports one side of a metal strip lattice assembly, the other side of which is supported by a vertical tube fitting into spring clips on the first vertical structural member at the side of the door entrance. When the side barriers are installed, a webbing and horizontal tube barrier assembly can be fitted across them.

11. Power Sources

The power sources and circuit-breakers for the systems described in this Section are as follows:

	Quantity
A. D.C. Essential Bus Panel A	
Hydraulic System - Freight Door Valves	1
Door Open Warning	1
Ordinance Lights	1
B. D.C. Main Bus	
Attendants Call and Toilet Lights	1


NET TIE-DOWN FITTING
(TYPICAL AT BOTTOM ATTACHMENT ALL CARGO NETS)
A
B
A COMPARTMENT BARRIER NET
ATTACHMENT TO FORWARD TRANSVERSE BARRIER NET (Not shown.)
B SWING-TAIL SEPARATOR NET
44D4-OM-21-4


C
VIEW OF NET ATTACHMENT SHACKLE
Similar at twelve transverse positions for each inter-pallet barrier net location.
D-RINGS
Use when cinching net.
PALLET
ARRANGEMENT OF PALLET OVERTHROW NET
C
INTER-PALLET BARRIER NET
(Up to nine may be used in ten locations.)
44D4-OM-21-5

4011-3/76

INTRA-COMPANY CORRESPONDENCE

READ, and initial on 2d Page Please
Joe

TO (NAME & LOCATION)
All CL-44 Aircrew Members

DATE
March 31, 1981

CC TO

FROM (NAME & LOCATION)
Joe Dettle

SUBJECT
Tyne Engine Bleed Valves

REF.

As you all know, we lost three engines in less than a year from LP Compressor blade failures. Two of these engines are known to be LP 5 blade failures, which links directly to the Bleed Valve and its operation.

There is no conclusive evidence that these failures were a result of Bleed Valve malfunction, but the location of the 5th stage in the engine makes the Bleed Valve, and its operation, an important factor.

During my discussion with Rolls Royce Representatives in Montreal, they pointed out that the most critical time in Bleed Valve operation, is hot weather take off. Any premature opening of the Bleed Valve at 98.8% LPRPM can be catastrophic. The proper Bleed Valve opening at flight idle is critical, but not nearly so much as at take off.

Relative to Bleed Valve operation at take off RPM; I have enclosed a page from the Tyne Maintenance Manual. It states that a reduction in HPRPM, with constant LPRPM can cause compressor surges. I have also enclosed an RPM Relationship chart from the Maintenance Manual.

We have two problems in hot weather take off.

1. Premature opening of the Bleed Valve, with 98.5 HPRPM being normal in hot weather.
2. Engine surge as high as 97% HPRPM in hot weather.

HPRPM is critical during the take off. I have determined in flight that 10 clicks on the condition lever can reduce HPRPM 1% to 2%. Obviously, much reduction in the Condition lever setting at 98.8% LPRPM can be very detrimental to the engine.

From Tyne "Trouble Shooting Guides", I have listed some of the indications of Bleed Valve problems:

1. High TGT, with high HPRPM, suspect Bleed Valve open.
2. Low Torque, Bleed Valve could be open, also causing high TGT.
3. High HPRPM, Bleed Valve open, if Torque is low & TGT is high.
4. Banging Engine, Bleed Valve stuck, fuel trimmed too far back, any situation causing HPRPM to be too low for LPRPM.

What can we as aircrew members do to insure every possible precaution is taken to safeguard our engines?

1. All power changes should be smooth and not abrupt.
2. Condition lever should not be reduced over three clicks with LP at take off RPM. Any power reduction for high, TGT should be made with the Power Lever.
3. Care should be used when reducing to METO and Climb Power. Only minor movement of Condition Levers should be required. When reducing to METO Power, no Condition Lever movement should be required. Reducing to Climb Power should be coordinated with the Power Lever and Condition Lever.
4. Accurate and complete Engine Logs should be maintained. Entries are to be hourly. These logs are valuable in studying engine trends.
5. Charted Condition Lever position and nothing less, should be used for all take offs.

Additionally, the Maintenance Department should test all engines for proper Bleed Valve operation as soon as practical. Tests should also be made when required by component changes, or when problems are suspected.

Our history in Tyne operation has been better than the industry. However, we have a much higher percentage of LP-5 blade failures than any other operator. It is to our advantage to take every precaution in the normal operation of this engine to increase its life.

Thank you.

Joe Dettle
OJD/lmc

Marvin	MB
Leo	M
Walt	
Jim Ford	
Fray	
Hall	
Mike	
Phillips	P
Bill	
Marshall	
Maury	
Inwood	B

[illegible] w/o windshield heat

Windshield heat [illegible] temp [illegible]
heating is greater in High

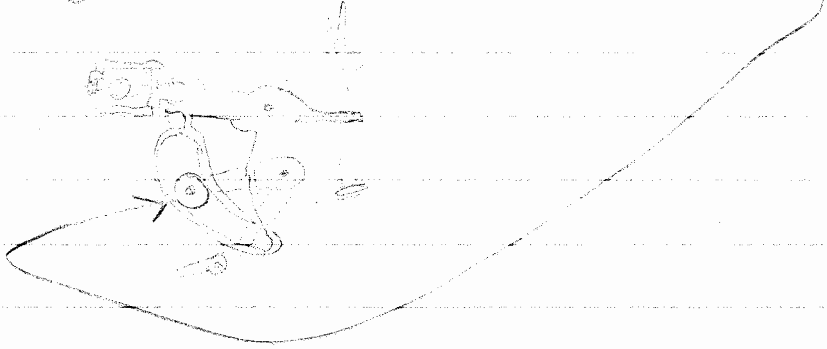
Sources of heat [illegible]

[illegible]

[illegible]

ADLS automatic drag limiting system
mechanically [illegible] by Rudder [illegible] ~~[illegible]~~ during
eng fail [illegible] pitch [illegible]
to feather

[illegible] RPM Drift [illegible]
CR shaft governor. usually roller fails



The [illegible] hydraulic Pitch Lock
[illegible] pitch lock will [illegible]
[illegible] released.

[illegible] mechanical pitch lock?)